



Earth Resources
A Continuing
Bibliography
with Indexes

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Accession numbers cited in this Supplement fall within the following ranges.

STAR (N-10000 Series)

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A86-19291 – A86-29842

EARTH RESOURCES

A CONTINUING BIBLIOGRAPHY WITH INDEXES

Issue 50

A selection of annotated references to unclassified reports and journal articles that were introduced into the NASA scientific and technical information system and announced between April 1 and June 30, 1986 in

- *Scientific and Technical Aerospace Reports (STAR)*
- *International Aerospace Abstracts (IAA).*



Scientific and Technical Information Branch
National Aeronautics and Space Administration
Washington, DC

1986

This supplement is available from the National Technical Information Service (NTIS), Springfield, Virginia 22161, price code A06.

INTRODUCTION

The technical literature described in this continuing bibliography may be helpful to researchers in numerous disciplines such as agriculture and forestry, geography and cartography, geology and mining, oceanography and fishing, environmental control, and many others. Until recently it was impossible for anyone to examine more than a minute fraction of the Earth's surface continuously. Now vast areas can be observed synoptically, and changes noted in both the Earth's lands and waters, by sensing instrumentation on orbiting spacecraft or on aircraft.

This literature survey lists 523 reports, articles, and other documents announced between April 1 and June 30, 1986 in *Scientific and Technical Aerospace Reports (STAR)*, and *International Aerospace Abstracts (IAA)*.

The coverage includes documents related to the identification and evaluation by means of sensors in spacecraft and aircraft of vegetation, minerals, and other natural resources, and the techniques and potentialities of surveying and keeping up-to-date inventories of such riches. It encompasses studies of such natural phenomena as earthquakes, volcanoes, ocean currents, and magnetic fields; and such cultural phenomena as cities, transportation networks, and irrigation systems. Descriptions of the components and use of remote sensing and geophysical instrumentation, their subsystems, observational procedures, signature and analyses and interpretive techniques for gathering data are also included. All reports generated under NASA's Earth Resources Survey Program for the time period covered in this bibliography are also included. The bibliography does not contain citations to documents dealing mainly with satellites or satellite equipment used in navigation or communication systems, nor with instrumentation not used aboard aerospace vehicles.

The selected items are grouped in nine categories. These are listed in the Table of Contents with notes regarding the scope of each category. These categories were especially chosen for this publication, and differ from those found in *STAR* and *IAA*.

Each entry consists of a standard bibliographic citation accompanied by an abstract. The citations include the original accession numbers from the respective announcement journals.

Under each of the nine categories, the entries are presented in one of two groups that appear in the following order:

- IAA* entries identified by accession number series A86-10,000 in ascending accession number order;

- STAR* entries identified by accession number series N86-10,000 in ascending accession number order.

After the abstract section, there are seven indexes:

- subject, personal author, corporate source, foreign technology, contract number, report/ accession number, and accession number.

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TYPICAL REPORT CITATION AND ABSTRACT

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ACCESSION NUMBER → **N86-12740*** # Kansas Univ. Center for Research, Inc., Lawrence. ← **CORPORATE SOURCE**
Remote Sensing Lab.

TITLE → **EVALUATION OF SPACE SAR AS A LAND-COVER CLASSIFICATION Final Report**

AUTHORS → **B. BRISCO, F. T. ULABY, and T. H. L. WILLIAMS** 1985, 123 p refs Original contains imagery. Original photography may be purchased from the EROS Data Center, Sioux Falls, S.D. 57198 ERTS ← **PUBLICATION DATE**

CONTRACT NUMBER → (Contract NCC9-7)

AVAILABILITY SOURCE → (E86-10004; NASA-CR-176267; NAS 1.26:176267; RSL-TR-605-1) ← **REPORT NUMBERS**
Avail: NTIS HC A06/MF A01 CSCL 02B ← **COSATI CODE**

The multidimensional approach to the mapping of land cover, crops, and forests is reported. Dimensionality is achieved by using data from sensors such as LANDSAT to augment Seasat and Shuttle Image Radar (SIR) data, using different image features such as tone and texture, and acquiring multirate data. Seasat, Shuttle Imaging Radar (SIR-A), and LANDSAT data are used both individually and in combination to map land cover in Oklahoma. The results indicates that radar is the best single sensor (72% accuracy) and produces the best sensor combination (97.5% accuracy) for discriminating among five land cover categories. Multirate Seasat data and a single data of LANDSAT coverage are then used in a crop classification study of western Kansas. The highest accuracy for a single channel is achieved using a Seasat scene, which produces a classification accuracy of 67%. Classification accuracy increases to approximately 75% when either a multirate Seasat combination or LANDSAT data in a multisensor combination is used. The tonal and textural elements of SIR-A data are then used both alone and in combination to classify forests into five categories. Author

TYPICAL JOURNAL ARTICLE CITATION AND ABSTRACT

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ACCESSION NUMBER → **A86-15608*** # National Aeronautics and Space Administration, Washington, D.C.

TITLE → **BIOGEOCHEMICAL CYCLING IN TERRESTRIAL ECOSYSTEMS - MODELING, MEASUREMENT, AND REMOTE SENSING**

AUTHORS → **D. L. PETERSON, P. A. MATSON, J. G. LAWLESS (NASA, Ames Research Center, Moffett Field, CA), J. D. ABER (Wisconsin, University, Madison), P. M. VITOUSEK (Stanford University, CA) et al.** IAF, International Astronautical Congress, 36th, Stockholm, Sweden, Oct. 7-12, 1985. 13 p. refs ← **AUTHOR'S AFFILIATION**

REPORT NUMBER → (IAF PAPER 85-14) ← **MEETING DATE**

The use of modeling, remote sensing, and measurements to characterize the pathways and to measure the rate of biogeochemical cycling in forest ecosystems is described. The application of the process-level model to predict processes in intact forests and ecosystems response to disturbance is examined. The selection of research areas from contrasting climate regimes and sites having a fertility gradient in that regime is discussed, and the sites studied are listed. The use of remote sensing in determining leaf area index and canopy biochemistry is analyzed. Nitrous oxide emission is investigated by using a gas measurement instrument. Future research projects, which include studying the influence of changes on nutrient cycling in ecosystems and the effect of pollutants on the ecosystems, are discussed. I.F.

EARTH RESOURCES

A Continuing Bibliography (Issue 50)

JULY 1986

01

AGRICULTURE AND FORESTRY

Includes crop forecasts, crop signature analysis, soil identification, disease detection, harvest estimates, range resources, timber inventory, forest fire detection, and wildlife migration patterns.

A86-19477

REVIEW OF MODELS AND MEASUREMENTS OF MULTISPECTRAL REFLECTANCE BY PLANT CANOPIES - RECOMMENDATIONS FOR FUTURE RESEARCH

N. J. J. BUNNIK (Nationaal Lucht- en Ruimtevaartlaboratorium, Amsterdam, Netherlands) IN: Remote sensing; Proceedings of the Meeting, Arlington, VA, May 1, 2, 1984. Bellingham, WA, SPIE - The International Society for Optical Engineering, 1984, p. 2-11. refs

Different vegetation canopy reflectance models have been reviewed. Several models based on the one-dimensional radiative transfer equation developed by Kubelka and Munk (1931) are discussed with respect to their suitability for remote sensing applications. Another class of models based on radiative transfer within a finite number of uniform layers has been treated as well. Out of numerous results obtained from canopy reflectance measurements, examples are given concerning cause-effect relationships, non-Lambertian reflectance, model verification, crop yield estimation and the assessment of the influence of the atmosphere and the observation geometry. Recommendations for future research are discussed, which are dealing with crop growth monitoring, model inversion and application of atmospheric correction models. The effect of the polarization of scattered radiation should be also investigated in relation to the increased interest in data acquisition under varying view angles. Author

A86-19482* Jet Propulsion Lab., California Inst. of Tech., Pasadena.

HIGH SPECTRAL RESOLUTION REMOTE SENSING OF THE LAND

A. F. H. GOETZ (California Institute of Technology, Jet Propulsion Laboratory, Pasadena) IN: Remote sensing; Proceedings of the Meeting, Arlington, VA, May 1, 2, 1984. Bellingham, WA, SPIE - The International Society for Optical Engineering, 1984, p. 56-68. NASA-supported research. refs

Spectral remote sensing has been practiced on a large scale since the launch of Landsat 1 in 1972. The limited information contained in this spectrally undersampled data set has led to the development of sophisticated statistical-inferential methods for data analysis. The results are usually limited by the availability of ground truth information. Recent technological developments have made it feasible to create narrow-band, contiguous, spectral image data sets that make possible the identification of surface cover materials based on the complete reflectance spectrum for each picture element. This capability will revolutionize the use of remote sensing data and require new deterministic image processing techniques to extract the full information content from the data. Sensors, based on the concept of imaging spectrometry and the new technology of area array infrared detectors, have been constructed

and are candidates for Shuttle and space platform flights.

Author

A86-19518

OPERATIONAL METEOROLOGICAL SATELLITE PRODUCTS FOR AGRICULTURAL MONITORING

J. D. TAPPLEY (NOAA, Satellite Applications Laboratory, Washington, DC) IN: Recent advances in civil space remote sensing; Proceedings of the Meeting, Arlington, VA, May 3, 4, 1984. Bellingham, WA, SPIE - The International Society for Optical Engineering, 1984, p. 222-230. refs

A project is underway at the National Environmental Satellite, Data, and Information Service to develop products derived from satellite data that will be useful to USDA for agricultural monitoring. The products fall into two categories: meteorological observations and direct observations of vegetation. The meteorological-type measurements are to supplement conventional ground-based weather observations from data sparse areas of the world. These include estimation of precipitation, maximum/minimum temperature, solar radiation, and snowcover. The algorithms to retrieve these quantities were developed to work from operationally available data and designed to be implemented in a near real-time operation. Direct observations of vegetation are interpreted by means of indexes consisting of mathematical combinations of observations in visible and near infrared bands. This paper briefly describes the algorithms used to estimate these quantities from operational data, discusses the expected accuracy of the products and reviews current problems. Author

A86-19519

CROPCAST - A REVIEW OF AN EXISTING REMOTE SENSOR-BASED AGRICULTURAL INFORMATION SYSTEM WITH A VIEW TOWARD FUTURE REMOTE SENSOR APPLICATIONS

E. S. MERRITT, L. HEITKEMPER, and K. MARCUS (Earth Satellite Corp., Chevy Chase, MD) IN: Recent advances in civil space remote sensing; Proceedings of the Meeting, Arlington, VA, May 3, 4, 1984. Bellingham, WA, SPIE - The International Society for Optical Engineering, 1984, p. 231-237.

A86-19520

GLOBAL CROP MONITORING - AN INTEGRATED APPROACH

R. S. AMBROZIAK (NOAA, Climate Impact Assessment Div., Washington, DC) IN: Recent advances in civil space remote sensing; Proceedings of the Meeting, Arlington, VA, May 3, 4, 1984. Bellingham, WA, SPIE - The International Society for Optical Engineering, 1984, p. 238-244.

An integrated climate impact monitoring system was developed using all available data sources including satellite data; in particular the NOAA AVHRR was used as a crop monitor. The project began with the basic premises of image interpretation and introduced the simplest and most widely accepted procedures into an existing operational process, with the aim of improving the accuracy and timeliness of the impact assessment reports without a large increase in resources. An integrated man/computer approach was used for the image analysis, pattern recognition, and data processing. B.J.

A86-19521* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

MICROWAVE REMOTE SENSING OF SOIL MOISTURE

T. J. SCHMUGGE (NASA, Goddard Space Flight Center, Greenbelt, MD) IN: Recent advances in civil space remote sensing; Proceedings of the Meeting, Arlington, VA, May 3, 4, 1984. Bellingham, WA, SPIE - The International Society for Optical Engineering, 1984, p. 249-257. Previously announced in STAR as N85-23235. refs

Because of the large contrast between the dielectric constant of liquid water and that of dry soil at microwave wavelength, there is a strong dependence of the thermal emission and radar backscatter from the soil on its moisture content. This dependence provides a means for the remote sensing of the moisture content in a surface layer approximately 5 cm thick. The feasibility of these techniques is demonstrated from field, aircraft and spacecraft platforms. The soil texture, surface roughness, and vegetative cover affect the sensitivity of the microwave response to moisture variations with vegetation being the most important. It serves as an attenuating layer which can totally obscure the surface. Research indicates that it is possible to obtain five or more levels of moisture discrimination and that a mature corn crop is the limiting vegetation situation. Author

A86-19522

ESTIMATING MOISTURE CONDITIONS FOR AVHRR DATA

J. C. PRICE (USDA, Agricultural Research Service Hydrology Laboratory, Beltsville, MD) IN: Recent advances in civil space remote sensing; Proceedings of the Meeting, Arlington, VA, May 3, 4, 1984. Bellingham, WA, SPIE - The International Society for Optical Engineering, 1984, p. 258-265. refs

Data sets collected through the Statistical Reporting Service of the USDA are used in an initial effort to test the utility of NOAA Advanced Very High Resolution Radiometer (AVHRR) data for soil moisture and crop yield assessment. The problem of verification of AVHRR data is chiefly one of spatial scale: the 1100-m scale of AVHRR data falls at the geometric mean of the scale of weather observations (hundreds of kilometers) and that of typical experimental ground truth (tens of meters). The physical and statistical formulations are discussed for dealing with the complex data sets, and the framework of a hypothetical operational system is addressed. The observing system of choice combines daily AVHRR passes with the infrequent but high spatial resolution data from Landsat or SPOT sensors. D.H.

A86-20660*# National Aeronautics and Space Administration. Earth Resources Lab., Bay St. Louis, Miss.

SPATIAL VARIATION ANALYSES OF THEMATIC MAPPER DATA FOR THE IDENTIFICATION OF LINEAR FEATURES IN AGRICULTURAL LANDSCAPES

R. E. PELLETIER (NASA, Earth Resources Laboratory, Bay St. Louis, MS) IN: Spatial information technologies for remote sensing today and tomorrow; Proceedings of the Ninth Pecora Symposium, Sioux Falls, SD, October 2-4, 1984. Silver Spring, MD, Institute of Electrical and Electronics Engineers, Inc., 1984, p. 62-68. refs

A need exists for digitized information pertaining to linear features such as roads, streams, water bodies and agricultural field boundaries as component parts of a data base. For many areas where this data may not yet exist or is in need of updating, these features may be extracted from remotely sensed digital data. This paper examines two approaches for identifying linear features, one utilizing raw data and the other classified data. Each approach uses a series of data enhancement procedures including derivation of standard deviation values, principal component analysis and filtering procedures using a high-pass window matrix. Just as certain bands better classify different land covers, so too do these bands exhibit high spectral contrast by which boundaries between land covers can be delineated. A few applications for this kind of data are briefly discussed, including its potential in a Universal Soil Loss Equation Model. Author

A86-20661

GIS FOR SOILS AND RANGELAND MANAGEMENT

R. G. BEST and F. C. WESTIN (South Dakota State University, Brookings) IN: Spatial information technologies for remote sensing today and tomorrow; Proceedings of the Ninth Pecora Symposium, Sioux Falls, SD, October 2-4, 1984. Silver Spring, MD, Institute of Electrical and Electronics Engineers, Inc., 1984, p. 70-74. refs

Large areas of rangeland that are being cultivated may be susceptible to soil erosion. These areas require extensive management in order to preserve the soil resource. Conventional field survey techniques for identifying and monitoring problem areas are not adequate or cost efficient. This investigation demonstrates how a computerized geographic information system (GIS) can be used in an operational soils and rangeland management program. A composite map of landuse (interpreted from Landsat imagery), soil capability class and slope was produced with the Area Resource Analysis System, a cellular GIS. Cultivated areas on capability classes V-VIII and/or slopes greater than 6 percent were identified as problem areas. In this pilot project area, more than 60 percent of the cultivated land (3922 hectares) was on soils not suited for cultivation. The GIS was also used to produce maps useful for formulating a management plan. Author

A86-20675

APPLICATION OF GEOGRAPHIC INFORMATION SYSTEM TO MANAGEMENT OF THE PENN STATE UNIVERSITY EXPERIMENTAL FOREST

W. L. MYERS and J. J. KOLENIK (Pennsylvania State University, University Park) IN: Spatial information technologies for remote sensing today and tomorrow; Proceedings of the Ninth Pecora Symposium, Sioux Falls, SD, October 2-4, 1984. Silver Spring, MD, Institute of Electrical and Electronics Engineers, Inc., 1984, p. 174-182. refs

Management of field research facilities requires storage, retrieval, and analysis of a wide variety of information structures with much of the data being of a locational nature. A georeferenced information system can be of considerable utility in this context if some special constraints are met. A suitable system has been developed at Penn State University and is being applied to management of an experimental forest. Author

A86-20679* Oregon State Univ., Corvallis.

SEGMENTATION OF COMPUTER-CLASSIFIED LANDSAT MULTISPECTRAL SCANNER DATA INTO SPATIALLY-CONNECTED REGIONS OF ELK HABITAT COMPONENTS

R. MURRAY (Oregon State University, Corvallis) IN: Spatial information technologies for remote sensing today and tomorrow; Proceedings of the Ninth Pecora Symposium, Sioux Falls, SD, October 2-4, 1984. Silver Spring, MD, Institute of Electrical and Electronics Engineers, Inc., 1984, p. 208-212. Research supported by Oregon State University and Oregon Department of Fish and Wildlife. refs
(Contract NGL-39-002-053)

Segmentation of computer-classified Landsat multispectral data into spatially-connected regions of ground cover is described. Sorting and hash addressing, techniques commonly used for ordering and searching data records keyed by attributes, are the basis for the region identification and extraction. An example based on the use of spatial regions for evaluating elk habitat components is outlined. Author

A86-21127#

THE ROLE OF LANDSAT DATA IN IMPROVING U.S. CROP STATISTICS

M. L. HOLKO and R. S. SIGMAN (USDA, Statistical Reporting Service, Washington, DC) IN: International Symposium on Remote Sensing of Environment, 18th, Paris, France, October 1-5, 1984, Proceedings. Volume 1. Ann Arbor, MI, Environmental Research Institute of Michigan, 1985, p. 307-320. refs

Landsat data are used in two ways to improve U.S. crop statistics. Landsat color-composite images are used to stratify areas

of land with regard to land use. This stratification is used as a technique to improve the efficiency of an area sampling frame. Also, Landsat digital data are classified and the classified results are used as supplementary information to an agricultural survey. The combination of Landsat classification results and survey data improves the precision of the estimates made. Author

A86-21128#

AGRICULTURAL STATISTICS AND REMOTE SENSING - FRENCH RESEARCH AND STUDIES WITH LANDSAT MSS AND SPOT SIMULATIONS

J. MEYER-ROUX, PH. FOURNIER (Ministere de l'Agriculture, Service Central des Enquetes et Etudes Statistiques, Paris, France), A. PODAIRE, and G. SAINT (CNRS and CNES, Laboratoire d'Etudes et de Recherches en Teledetection Spatiale, Toulouse, France) IN: International Symposium on Remote Sensing of Environment, 18th, Paris, France, October 1-5, 1984, Proceedings. Volume 1. Ann Arbor, MI, Environmental Research Institute of Michigan, 1985, p. 321-337. refs

A study is being conducted of the possibility of incorporating remote sensing data into the existing system of agricultural statistics. An experiment in 1981 with Landsat MSS showed that good results could not be achieved for two main reasons: MSS was not well adapted to the average field size and the point sampling survey was not efficient in combination with space data. From 1981 to 1983, SPOT simulations showed that good results could be obtained for localized statistics of crops if two conditions are fulfilled: two acquisition dates are required and times of acquisition must be carefully chosen to relate to crop calendars. D.H.

A86-21129#

THE EUROPEAN COMMUNITY'S AGRICULTURAL INFORMATION SYSTEM REQUIREMENTS AND REMOTE SENSING PROSPECTS

N. ROBSON (CEC, Directorate-General for Agriculture, Brussels, Belgium) IN: International Symposium on Remote Sensing of Environment, 18th, Paris, France, October 1-5, 1984, Proceedings. Volume 1. Ann Arbor, MI, Environmental Research Institute of Michigan, 1985, p. 339-345.

The possibilities offered by remote sensing in improving the status of information on European agriculture are recognized. Present methods are reviewed and particular difficulties relating to the use of remote sensing to obtain more accurate information are discussed. The degree of enhanced accuracy which must be obtained over present methods is examined and an evaluation of the error factor presented. By reference to work which attempts to put a cost on a remote sensing satellite system for agricultural applications, the relationship with the value of errors is indicated. The paper concludes by indicating that it is only a matter of time before remote sensing becomes an integrated part of the EC Agricultural Information System. Author

A86-21130#

AGRICULTURAL STATISTICS IN DEVELOPING COUNTRIES

W. H. WIGTON (Agricultural Assessments International, Upper Marlboro, MD) and C. K. PAUL (U.S. Agency for International Development, Washington, DC) IN: International Symposium on Remote Sensing of Environment, 18th, Paris, France, October 1-5, 1984, Proceedings. Volume 1. Ann Arbor, MI, Environmental Research Institute of Michigan, 1985, p. 349-354. refs

This paper explains a successful project in agricultural statistics that helped generate data in about ten developing countries on four continents. The methodology was tailored to the conditions in Africa, Asia, South America and Central America. In each country, the problems were jointly resolved by the technical consultants of the project and the host country personnel. In some countries, the satellite photographic data were of limited use because of the resolution of the multispectral scanner (MSS) data which was the only satellite data available. For this reason, the outlook for the future is good because of the improved resolution on both the TM and SPOT. Author

A86-21142*# City Univ. of New York, N.Y.

DISCRETE-OBJECT MODELING OF REMOTELY SENSED SCENES

A. H. STRAHLER (New York, City University, NY), C. E. WOODCOCK (Boston University, MA), L. XIAOWEN (California, University, Santa Barbara), and D. L. B. JUPP (CSIRO, Div. of Water and Land Resources, Canberra, Australia) IN: International Symposium on Remote Sensing of Environment, 18th, Paris, France, October 1-5, 1984, Proceedings. Volume 1. Ann Arbor, MI, Environmental Research Institute of Michigan, 1985, p. 465-473. refs

(Contract NAG5-273; NAS9-16664; NASA ORDER L-200080)

Remotely sensed scenes can be modeled as collections of discrete, three-dimensional objects that cast shadows on a background. Approaching scenes from this perspective has led to two related lines of research. First is the geometric/optical modeling of a forest canopy, in which conifers are modeled as cones whose size and spacing vary according to functions established by field measurements. This canopy model is 'L-resolution' in nature - the objects are smaller than the resolution cells of the image and cannot be resolved individually. Second is scene modeling in which image variance is taken as a function of the relationship between the size, shape and spacing of objects and the resolution cell size of the digital image derived from the scene. This modeling is 'H-resolution' in nature - the objects in the scene are assumed to be larger than the resolution cells of the image, and thus can be individually distinguished. Both approaches illustrate the utility of the discrete-object scene model in extracting information from remotely sensed scenes. Author

A86-21143#

ROTATION OF SPECTRAL CHANNEL AXES - APPLICATION TO A RICE GROWING AREA OF WEST AFRICA

A. BERG and A. HUBAUX (CEC, Joint Research Centre, Ispra, Italy) IN: International Symposium on Remote Sensing of Environment, 18th, Paris, France, October 1-5, 1984, Proceedings. Volume 1. Ann Arbor, MI, Environmental Research Institute of Michigan, 1985, p. 475-489.

Simulated data were obtained by two flights at three-week intervals shortly before harvest, in the Mopti-Sabe region (Mali) over traditional rice fields, cultivated without control of the submersion conditions. Strong geometric distortion prevents image registration; for monotemporal data, the most satisfactory approach was found to be the 'Soil Vegetation Water' method described in the paper. It consists in rotating the three original channel axes into secondary axes going from the origin to representative points of the three objects. The vegetation channel constitutes a green biomass index, the water channel gives a map of water saturation, and the derived color composite shows details hidden in the original channels. By the use of a box classifier, a thematic map is obtained. Classification results are analyzed by confusion matrices. The method presents several advantages: simplicity, short computer time and possibility to use an interactive classifier. Author

A86-21144#

USE OF GROUND RADIOMETRY MEASUREMENTS (IN A TROPICAL RICE-GROWING ENVIRONMENT) AS A KEY TO THE INTERPRETATION OF A SECOND-GENERATION SATELLITE IMAGERY

G. M. FERRARI and J. M. GREGOIRE (CEC, Joint Research Centre, Ispra, Italy) IN: International Symposium on Remote Sensing of Environment, 18th, Paris, France, October 1-5, 1984, Proceedings. Volume 1. Ann Arbor, MI, Environmental Research Institute of Michigan, 1985, p. 491-501. refs

Under a remote-sensing-based rice production forecasting program in West Africa (the rice growing area of Tamani in Mali), radiometric measurement campaigns were performed over three years. The analysis of the measurement data in the visible and infrared regions has provided information on the influence of certain yield parameters on the spectral behavior of rice plants and led to the definition of interpretation keys for the use of second generation satellite images such as Landsat-4 and SPOT. The 1983 campaign (November and December) has allowed this work

to be extended and completed in the three following domains: discrimination of the three main categories of aquatic vegetation during the phenological stages of broothing and earing; contribution of oblique data (at 45 deg) in relation to vertical data for the characterization of spectral behavior; and spatial variability of the spectral responses within a plot at a given moment in the growth cycle of rice plants. Author

A86-21145# EVALUATION OF A SAR IMAGE FOR USE IN THE CLASSIFICATION OF VEGETATION COVER

B. ABEDNEGO, T. BLASER, R. CALOZ, and P. MEYLAN (Lausanne, Ecole Polytechnique Federale, Switzerland) IN: International Symposium on Remote Sensing of Environment, 18th, Paris, France, October 1-5, 1984, Proceedings. Volume 1. Ann Arbor, MI, Environmental Research Institute of Michigan, 1985, p. 503-510. refs

An evaluation of numerical synthetic aperture radar (SAR) image processing procedures for classification of vegetation cover (gathered over the region of St. Aubin, Switzerland) is presented. The procedures used for data processing and interpretation and the methods applied in vegetation cover classification are described. In addition to 'pixel-by-pixel' classification, 'parcel-by-parcel' classification was carried out with the use of a preliminarily computed field boundary data file. The results show smoothed image, permitting a satisfactory classification of cereals. To discriminate between bare soil, grassland, and colza, however, textural information is necessary. I.S.

A86-21147# SPOT-SIMULATION - AN EVALUATION FOR FOREST INVENTORY AND MAPPING PURPOSES

S. JAAKKOLA, D. ROSENHOLM, and L. ISAKSSON (Swedish University of Agricultural Sciences, Umea, Sweden) IN: International Symposium on Remote Sensing of Environment, 18th, Paris, France, October 1-5, 1984, Proceedings. Volume 1. Ann Arbor, MI, Environmental Research Institute of Michigan, 1985, p. 521-528. refs

Simulated SPOT-satellite data are being evaluated for forest inventory and mapping purposes at the Swedish University of Agricultural Sciences in co-operation with EARSeL/WG5. The material, methods, and previous simulation studies are discussed in this preliminary report. General conclusions on the methods used are: (1) SPOT-data, with high spatial resolution, will benefit from the use of multi-point instead of single-point classifiers; (2) various texture measures should be used for an improved performance in classification; and (3) forest cover type classification into four classes was successful with an overall classification accuracy of 90 percent or more. Author

A86-21148# EFFECTIVE ESTIMATION OF AGRICULTURAL CROP HECTARAGE IN DEVELOPING COUNTRIES

N. E. G. ROLLER (Michigan, Environmental Research Institute, Ann Arbor) IN: International Symposium on Remote Sensing of Environment, 18th, Paris, France, October 1-5, 1984, Proceedings. Volume 1. Ann Arbor, MI, Environmental Research Institute of Michigan, 1985, p. 529-534.

An issue of major concern to most developing countries is the production of accurate, reliable and timely agricultural statistics. An inventory methodology is described in this paper, which when judged according to these criteria, has been shown to offer improved performance compared to traditional (field only) or remote sensing only inventories. The advantages of both of these latter approaches are retained in the improved methodology, while the disadvantages of each are largely overcome. The improved methodology uses a combined approach that consists of a double sampling estimation procedure, in which one of the samples is collected by remote sensing and the other by field methods. The estimate derived from the remote sensing sample is then 'bias-corrected' using the relationship observed between remote sensing and field only measurements collected on joint sample units. The effectiveness of the methodology is illustrated by

descriptions of wheat inventory projects in Algeria and Nepal.

Author

A86-21150# DETECTION OF SUGAR CANE GROWING STAGES BY MEANS OF COMPUTER-AIDED ANALYSIS OF LANDSAT DATA

J. C. DE LA TORRE (Direccion General de Geographia, Mexico City, Mexico) and J. I. MIRANDA (Universidad Nacional Autonoma de Mexico, Villa Obregon) IN: International Symposium on Remote Sensing of Environment, 18th, Paris, France, October 1-5, 1984, Proceedings. Volume 1. Ann Arbor, MI, Environmental Research Institute of Michigan, 1985, p. 543-553. refs (Contract CONACYT-PCECCNA-722418)

A single Landsat image was used to classify growing stages of sugar cane in the Tamazula, Mexico, region where sugar cane fields are not seeded at the same time. Three spectral vegetation indices were tested (GVI, DVI6, and TVI6) using a randomized complete block design. The height of several sugar cane plantations was recorded in a field two and three days before the Landsat image was taken. Later, using a photomosaic (1:20,000) and topographic maps (1:50,000), a set of at least eight training fields was selected from each sugar cane stage and entered into the computer as reference data. It was found that the GVI and the DVI6 indices, both more powerful than the TVI6 index, were sufficiently sensitive to detect different stages (e.g., a newly seeded field, near-mature and mature sugar cane, etc.) of development for sugar cane fields with 100 percent ground cover. The TV index is limited to distinguishing stages of sugar cane from emergence to 1.2 m in height, unless data are atmospherically corrected for the path-radiance term. It is believed that a growing model for sugar cane can be developed from the characteristic growing stages obtained from a single image. I.S.

A86-21160# FEASIBILITY OF USING GOES SATELLITE-DERIVED DATA TO ESTIMATE INCOMING SOLAR RADIATION IN THE PRADERA PAMPEANA, ARGENTINA

C. ESPOZ and A. BRIZUELA (Comision Nacional de Investigaciones Espaciales, Buenos Aires, Argentina) IN: International Symposium on Remote Sensing of Environment, 18th, Paris, France, October 1-5, 1984, Proceedings. Volume 2. Ann Arbor, MI, Environmental Research Institute of Michigan, 1985, p. 661-674. refs

A86-21168# MONITORING GLOBAL VEGETATION FROM METEOROLOGICAL SATELLITE DATA

J. D. TARPLEY (NOAA, National Environmental Satellite, Data, and Information Service, Camp Springs, MD) IN: International Symposium on Remote Sensing of Environment, 18th, Paris, France, October 1-5, 1984, Proceedings. Volume 2. Ann Arbor, MI, Environmental Research Institute of Michigan, 1985, p. 773-784.

The Advanced Very High Resolution Radiometer (AVHRR) on the NOAA series polar orbiting weather satellite allows routine monitoring of global vegetation. AVHRR visible and near infrared data are processed into a quantity called a vegetation index that is a measure of the greenness, vigor, or density of vegetation. The vegetation index values as well as the radiances from which they are calculated are mapped into global polar stereographic arrays. Daily vegetation index values are composited by saving the greenest value for 7 days to provide a relatively cloud free weekly product. Vegetation index maps have been produced for both hemispheres on a daily and weekly basis since April 1982.

Author

A86-21169#**A COMPARISON OF LANDSAT-MSS, HCMM AND NOAA-AVHRR FEATURES FOR IDENTIFYING DOMINANT VEGETATION PATTERNS IN MEDITERRANEAN AREAS**

B. LACAZE, G. DEBUSSCHE, A. KHELFA, H. MAZUREK, S. RAMBAL (CNRS, Centre d'Etudes Phytosociologiques et Ecologiques, Montpellier, France) et al. IN: International Symposium on Remote Sensing of Environment, 18th, Paris, France, October 1-5, 1984, Proceedings. Volume 2. Ann Arbor, MI, Environmental Research Institute of Michigan, 1985, p. 787-802. refs

(Contract EURATOM-2283-83-12EDISPF)

In this study are considered multitemporal data from 3 satellite sensors in the visible and near infrared domain. Physical values (albedos) and normalized difference vegetation index are derived in view of characterizing Mediterranean-type ecosystems. Relationships between these spectral indicators and tree cover are obtained from Landsat data for 3 dominant species and proposed as a basis for a multisensor approach of vegetation monitoring. Related problems of multitemporal and multisensor intercalibration of data are discussed. Author

A86-21170#**EXPERIMENTAL STUDY OF THE POTENTIAL OF SPOT IMAGERY FOR CROP IDENTIFICATION AND MONITORING**

G. GUYOT, M. VERBRUGGHE (Institut National de la Recherche Agronomique, Montfavet, France), and P. CAMPAGNE (Institut Geographique National, Saint-Mande, France) IN: International Symposium on Remote Sensing of Environment, 18th, Paris, France, October 1-5, 1984, Proceedings. Volume 2. Ann Arbor, MI, Environmental Research Institute of Michigan, 1985, p. 803-812. refs

A series of airborne measurements has been carried out in the south-east region of France on the Plateau de Valensole to study the potential of SPOT imagery for crop identification and monitoring. Radiometer measurements were performed from a small aircraft along one east-west axis with both nadir and oblique views. The axis crossed a sample of crops of this area: soft and hard wheat, barley, and lavender. The collected data show the utility of combining vertical and oblique measurements for crop discrimination. The correlation factor between the visible and the near-IR channels could be of use as an indicator of crop development. D.H.

A86-21175#**APPLICATIONS OF LANDSAT MSS AND TM DATA FOR AGRICULTURAL DEVELOPMENT PLANNING IN MOROCCO AND THE SOUTHERN SUDAN**

T. E. BEAUMONT (Scott Wilson Kirkpatrick and Partners, Basingstoke, England) IN: International Symposium on Remote Sensing of Environment, 18th, Paris, France, October 1-5, 1984, Proceedings. Volume 2. Ann Arbor, MI, Environmental Research Institute of Michigan, 1985, p. 895-901. refs

A86-21176#**APPLICATIONS OF RADAR (SLAR GOODYEAR AND SIR-A) RADAR AND SATELLITE (LANDSAT) IMAGERY IN A GEOMORPHOLOGICAL AND SOIL SURVEY IN THE VENEZUELAN AMAZON [APPLICATIONS THEMATIQUES D'IMAGERIES RADAR (SLAR GOODYEAR ET SIR-A) ET SATELLITE (LANDSAT) DANS UN INVENTAIRE GEOMORPHO-PEDOLOGIQUE EN AMAZONIE VENEZUELIENNE]**

M. POUYLLAU (CNRS, Centre d'Etudes de Geographie Tropicale, Talence, France) and P. BLANCANEUX (Institut Francais de Recherche Scientifique pour le Developpement en Cooperation, Bondy, France) IN: International Symposium on Remote Sensing of Environment, 18th, Paris, France, October 1-5, 1984, Proceedings. Volume 2. Ann Arbor, MI, Environmental Research Institute of Michigan, 1985, p. 903-910. In French. refs

A86-21177#**A NEW METHOD OF INCORPORATING METEOROLOGICAL SATELLITE DATA INTO GLOBAL CROP MONITORING**

R. A. AMBROZIAK (NOAA, Climate Impact Assessment Div., Washington, DC) IN: International Symposium on Remote Sensing of Environment, 18th, Paris, France, October 1-5, 1984, Proceedings. Volume 2. Ann Arbor, MI, Environmental Research Institute of Michigan, 1985, p. 921-929. refs

An inexpensive and effective method of monitoring vegetation using NOAA-AVHRR satellite data is presented as an integral part of a global crop monitoring system. The satellite monitoring subsystem increases the value of the meteorological and agronomical subsystems, but cannot stand alone as an assessment system. The satellite monitoring subsystem is based on a new color coordinate system which maximizes the information content of satellite images and minimizes the analysis time. The color coordinate system is described and compared to other systems. Author

A86-21184#**PER-FIELD CLASSIFICATION AND APPLICATION TO SPOT SIMULATED, SAR AND COMBINED SAR-MSS DATA**

J. MEGIER, W. MEHL (CEC, Joint Research Centre, Ispra, Italy), and R. RUPPELT (Berlin, Technische Universitaet, West Germany) IN: International Symposium on Remote Sensing of Environment, 18th, Paris, France, October 1-5, 1984, Proceedings. Volume 2. Ann Arbor, MI, Environmental Research Institute of Michigan, 1985, p. 1011-1018.

A classification method, using global statistics defined over individual fields, is proposed for discrimination and inventory of agricultural land occupation classes. It is compared with pixel by pixel classification in the case of SPOT simulated visible-IR data. It is also tested with SAR data and combinations of visible-IR data where the speckle effect is a major difficulty. The results show an improvement around 18 percent in the classification accuracy in the first case and a discrimination performance better than 90 percent for 5 agricultural categories in the second case. Author

A86-21185#**DIAGNOSIS OF FOREST RECOVERY IN EAST REGION OF KYOTO USING LANDSAT DATA**

T. SENOO, E. IWANAMI, K. HOSHINO (Kyoto Prefectural University, Japan), S. TANAKA, and T. SUGIMURA (Remote Sensing Technology Center of Japan, Tokyo) IN: International Symposium on Remote Sensing of Environment, 18th, Paris, France, October 1-5, 1984, Proceedings. Volume 2. Ann Arbor, MI, Environmental Research Institute of Michigan, 1985, p. 1019-1029. refs

A86-21186#**EVALUATION OF GROUND-BASED HOT-SPOT REFLECTANCE MEASUREMENTS FOR BIOMASS DETERMINATION OF AGRICULTURAL CROPS**

N. J. J. BUNNIK, W. VERHOEF, R. W. DE JONGH (Nationaal Lucht- en Ruimtevaartlaboratorium, Amsterdam, Netherlands), H. W. J. VAN KASTEREN, R. H. M. E. GEERTS (Centrum voor Agrobiologisch Onderzoek, Wageningen, Netherlands) et al. IN: International Symposium on Remote Sensing of Environment, 18th, Paris, France, October 1-5, 1984, Proceedings. Volume 2. Ann Arbor, MI, Environmental Research Institute of Michigan, 1985, p. 1033-1040. refs

Canopy reflectance simulation studies have demonstrated that a simplified relation between leaf area index and reflectance exists for the hot-spot observed at a zenith angle of approximately 52 deg. Based on this principle a prototype ground-based hot-spot reflectance meter (HSM) has been developed and tested. The objective of the project is to verify the performance for nondestructive determination of biomass and growth stage development of agricultural crops under standardized conditions. During 1982 and 1983 an extensive field measurement program has been executed. Results obtained in 1983 are discussed. HSM data can be applied for biomass assessment during the vegetative

phase. During the generative phase of cereals, change of biomass is detected due to the associated change of canopy color during ripening and senescence. This new ground-based instrument can be used in agricultural research and for ground truth collection in remote sensing. Author

A86-21187#

NOAA AVHRR DATA AS A TOOL FOR AGRICULTURAL MONITORING

Y. KERR, P. Y. DESCHAMPS, and G. SAINT (CNES, Toulouse, France) IN: International Symposium on Remote Sensing of Environment, 18th, Paris, France, October 1-5, 1984, Proceedings. Volume 2. Ann Arbor, MI, Environmental Research Institute of Michigan, 1985, p. 1041-1048. CNRS-CNES-supported research. refs

NOAA/AVHRR (Advanced Very High Resolution Radiometer) data with a ground resolution of 1 km are geometrically and radiometrically processed to provide various types of users with useful output products on an every day basis. Output consist of a cloud analysis and the physical properties of the surface: reflectances in the visible, near infrared and 3.7 micron channels, brightness and vegetation indices. Preliminary results are shown over France. Thanks to the daily global coverage of the AVHRR experiment, they appear attractive for an operational survey of large areas in remote sensing applications characterized by short time evolutions. Author

A86-21188#

INVESTIGATION INTO THE MID-IR SPECTRAL BAND BEST SUITED TO MONITORING VEGETATION WATER CONTENT - PRELIMINARY RESULTS

G. GUYOT, H. JOANNES, C. PRIEUR (Institut National de la Recherche Agronomique, Montfavet, France), O. DUPONT (Sherbrooke, Universite, Canada), M. HUET (CEMAGREF, Castanet Tolosan, France) et al. IN: International Symposium on Remote Sensing of Environment, 18th, Paris, France, October 1-5, 1984, Proceedings. Volume 2. Ann Arbor, MI, Environmental Research Institute of Michigan, 1985, p. 1049-1063. refs (Contract CNES-84; CNES-5024)

Main results are given of research attempting to determine the best spectral domains to monitor water content of plants, based on an experiment conducted on wheat and maize canopies during the growing period. Unusual weather conditions caused geometrical parameters of the canopy and plant water content to evolve simultaneously, making it difficult to analyze the influence of the separate parameters. High correlation was seen between the two SWIR bands (TM5 and TM7). The high correlation between SWIR (TM7) and visible (SPOT 2) shows the important effect of ground cover on SWIR response. Both water content and canopy geometry influenced SWIR response. D.H.

A86-21189#

CONTRIBUTION TO THE EVALUATION OF SOIL CHARACTERISTICS USING SATELLITE DATA

M. RAFFY, C. BUSQUET, and F. BECKER (Strasbourg I, Universite, France) IN: International Symposium on Remote Sensing of Environment, 18th, Paris, France, October 1-5, 1984, Proceedings. Volume 2. Ann Arbor, MI, Environmental Research Institute of Michigan, 1985, p. 1065-1073. CNES-CNRS-supported research. refs

Two general models are proposed to obtain agrometeorological and geological parameters such as thermal inertia and evapotranspiration flux over large regions of our planet from both visible and thermal infrared data obtained from satellites. Assuming knowledge of air humidity, air temperature and wind speed at 2 m, it is possible to obtain the surface parameters from satellite data. It is supposed that there exist effective parameters for heterogeneous pixels which obey the local model and that the slab defined by the pixel has a vertical homogeneity. D.H.

A86-21192#

DETECTION OF HEAVY METAL STRESSED VEGETATION USING LANDSAT DIGITAL DATA

C. BANNINGER (Technische Universitaet und Forschungszentrum Graz, Institut fuer digitale Bildverarbeitung und Graphik, Graz, Austria) IN: International Symposium on Remote Sensing of Environment, 18th, Paris, France, October 1-5, 1984, Proceedings. Volume 2. Ann Arbor, MI, Environmental Research Institute of Michigan, 1985, p. 1101-1105. refs

A pine tree stand growing in the Pyrite Belt (Rio Tinto area) of southwestern Spain displays a strong relationship between Landsat MSS canopy radiance values and high concentrations of copper, lead, and zinc in the underlying soil. Statistical analysis of the spectral and geochemical data from the pine tree stand shows a strong negative correlation between Landsat MSS bands 6 and 7 and soil copper and lead content, and a weaker, although similar relationship with respect to zinc. Less strong but good correlations are also shown by the first two principal components with respect to lead. These relationships, in conjunction with ground data, suggest that an increase in canopy exposure of low reflecting background material (pine needle litter) occurs as a consequence of a reduction in pine tree needle density associated with increased heavy metal content in the soil. Author

A86-21200#

THE APPLICABILITY OF LANDSAT IN AN EXPLORATORY SOIL SURVEY ON THE CENTRAL AFRICAN PLATEAU

R. N. MAGAI, T. WEN (Department of Agriculture, Lusaka, Zambia), R. LAURIN (Michigan, Environmental Research Institute, Ann Arbor), and S. KALYANGO (Regional Remote Sensing Facility, Nairobi, Kenya) IN: International Symposium on Remote Sensing of Environment, 18th, Paris, France, October 1-5, 1984, Proceedings. Volume 2. Ann Arbor, MI, Environmental Research Institute of Michigan, 1985, p. 1207-1215. refs

An exploratory soil survey on a scale of 1:500,000 of 8 million hectares was carried out in the northwestern province of Zambia with the aid of Landsat images. Interpretation of the standard dry-season Landsat MSS scenes was followed by a four-month field checking period. The strength of this approach lies mainly in increasing the accuracy of the delineation of the mapping units and providing a better basis for making fewer but more meaningful field observation - a substantial advantage in many developing countries. D.H.

A86-21204#

ESTIMATION OF HAIL DAMAGE IN AGRICULTURAL AREAS IN ARGENTINA BY DIGITAL INTERPRETATION OF LANDSAT DATA

A. B. BRIZUELA and M. C. SERAFINI (Comision Nacional de Investigaciones Espaciales, Buenos Aires, Argentina) IN: International Symposium on Remote Sensing of Environment, 18th, Paris, France, October 1-5, 1984, Proceedings. Volume 2. Ann Arbor, MI, Environmental Research Institute of Michigan, 1985, p. 1271-1281. refs

A86-21205#

DEVELOPMENT OF A SATELLITE-AIDED CROP ACREAGE ESTIMATION AND MAPPING SYSTEM FOR THE STATE OF CALIFORNIA

R. W. THOMAS, L. H. BECK, C. E. BROWN, and S. L. WALL (California, University, Berkeley) IN: International Symposium on Remote Sensing of Environment, 18th, Paris, France, October 1-5, 1984, Proceedings. Volume 2. Ann Arbor, MI, Environmental Research Institute of Michigan, 1985, p. 1283-1294. refs (Contract USDA-58-319T-2-0341X)

A study is currently underway in California to develop an operational system for Landsat-aided agricultural and land cover inventory. Data, processing, and resulting estimates and map products are to be shared between Federal and State users. Research has focused on two tasks: development of procedures for small grains mapping and acreage estimation, and development of procedures for use in yearly, statewide multiple crop inventory. Results for the two small grains digital classification procedures

are presented. Methods and results for several experiments leading to the specification of a multiple crop system to be tested during 1985 are also summarized. Author

A86-21206*# Technicolor Government Services, Inc., Moffett Field, Calif.

ATMOSPHERIC EFFECTS ON THE REMOTE SENSING ESTIMATION OF FOREST LEAF AREA INDEX

M. A. SPANNER (Technicolor Government Services, Inc., Moffett Field, CA), D. L. PETERSON, R. C. WRIGLEY, D. H. CARD (NASA, Ames Research Center, Moffett Field, CA), M. J. HALL (Oregon State University, Corvallis) et al. IN: International Symposium on Remote Sensing of Environment, 18th, Paris, France, October 1-5, 1984, Proceedings. Volume 2. Ann Arbor, MI, Environmental Research Institute of Michigan, 1985, p. 1295-1308. NASA-supported research. refs

An analysis is presented of the magnitude and variability of the effect of the atmosphere on high-altitude Daedalus Airborne Thematic Mapper data. By regressing ATM radiances against ground radiances (from measurements by a helicopter-mounted Barnes Modular Multiband Radiometer), it was possible to account for atmospheric conditions and variability across a 250 km transect in Oregon to estimate coniferous forest leaf area index. The technique permitted scene contrast to be increased, providing an improved capability for measurement of ground feature radiance. D.H.

A86-21207#
MULTIDIMENSIONAL (SPECTRAL AND TEXTURAL) CLASSIFICATION METHOD AND SURFACE STATES MAPPING, APPROACH TO THE AGRICULTURAL ENVIRONMENT USING LANDSAT DATA IN NORTHERN AND NORTHEASTERN THAILAND

C. MONKOLSAWAT (Khon Kaen University, Thailand), M. BRUNEAU (CNRS, Centre d'Etudes de Geographie Tropicale, Talence, France), J. KILIAN (Groupement d'Etudes et de Recherches pour le Developpement de l'Agronomie Tropicale, Institut de Recherches Agronomiques Tropicales et des Cultures Vivrieres, Paris, France), P. H. RAKARIYATHAM (Chiang Mai University, Thailand), D. DUCROS-GAMBART (CNRS, Centre d'Etudes Spatiales des Rayonnements, Toulouse, France) et al. IN: International Symposium on Remote Sensing of Environment, 18th, Paris, France, October 1-5, 1984, Proceedings. Volume 3. Ann Arbor, MI, Environmental Research Institute of Michigan, 1985, p. 1309-1319. refs

Multispectral and textural supervised classifications of four Landsat CCTs have been used in two different agricultural areas of Thailand (mountains of the North, flat alluvial plain of the Mun river alternatively inundated and very dry) to produce surface states maps. Field observations, choice of the date, good quality of the data and of the visualization to allow an accurate location of the training fields are of paramount importance. The agricultural environments can be approached through agro-ecological landscape units that are associations of surface states delineated on the classified image. Crossing of classified images of different dates superimposed is a good method to study the evolution of the landscapes in its broad features. Author

A86-21214#
APPLICATION OF REMOTELY SENSED DIGITAL DATA AND A GEOGRAPHIC INFORMATION SYSTEM IN THE NATIONAL WILDLIFE REFUGE PLANNING PROCESS IN ALASKA

J. HENDERSON (U.S. Fish and Wildlife Service, Anchorage, AK) IN: International Symposium on Remote Sensing of Environment, 18th, Paris, France, October 1-5, 1984, Proceedings. Volume 3. Ann Arbor, MI, Environmental Research Institute of Michigan, 1985, p. 1395-1403.

A86-21216#

INTEGRATION OF REMOTE SENSING DATA FOR MOORLAND MAPPING IN NORTHERN ENGLAND

R. E. WEAVER (Durham, University, England) IN: International Symposium on Remote Sensing of Environment, 18th, Paris, France, October 1-5, 1984, Proceedings. Volume 3. Ann Arbor, MI, Environmental Research Institute of Michigan, 1985, p. 1417-1423.

A number of remote sensing data sets are examined to assess their potential for moorland mapping. Generally, the major communities are separable in Landsat data, a finer pixel size is needed to extract detail. The optimum position and number of spectral regions for fine scale mapping is specific to each vegetation type. Author

A86-21220#

THE USE OF REMOTE SENSING AND DETAILED PLANT USE INFORMATION FOR DEVELOPING A VEGETATION RESOURCE BASE MAP FOR USE IN INTEGRATED RESOURCE PLANNING IN WEST AFRICA

C. J. DORIGAN (Tibbets-Abbott-McCarthy-Stratton, New York) IN: International Symposium on Remote Sensing of Environment, 18th, Paris, France, October 1-5, 1984, Proceedings. Volume 3. Ann Arbor, MI, Environmental Research Institute of Michigan, 1985, p. 1453-1462. refs

Landsat image interpretation is being used as an important means of land resources interpretation in integrated resource inventories covering extensive areas in West Africa. A significant amount of detailed plant use information exists for these regions being surveyed that has not yet been incorporated into the inventory maps and reports. Fish and Wildlife Habitat Suitability Index development procedures provide a model for integrating vegetation use information into these existing and future remote sensing/resource inventory data bases. Author

A86-21222#

DEER CENSUS USING A MULTISPECTRAL LINEAR ARRAY INSTRUMENT

C. L. WYATT, D. R. ANDERSON, R. HARSHBARGER (Utah State University of Agriculture and Applied Science, Logan), and M. M. TRIVEDI (Louisiana State University, Baton Rouge) IN: International Symposium on Remote Sensing of Environment, 18th, Paris, France, October 1-5, 1984, Proceedings. Volume 3. Ann Arbor, MI, Environmental Research Institute of Michigan, 1985, p. 1475-1488. refs

An eight-year program has achieved success in detecting mule deer (*Odocoileus hemionus*) with a ground-based sensor as a precursor to an airborne census tool, for game management, which is capable of eliminating false counts and which provides an estimate of deer population. The system uses three ratio classifiers (0.74, 0.78, 0.86 micrometer ratioed with 1.0 micrometer) and scene brightness in the 1.0 micrometer band. Total population is estimated from the three partial counts using the capture-recapture algorithm. D.H.

A86-21223#

COUNTING BIG GAME BY AERIAL THERMOGRAPHY IN THE ARC-EN-BARROIS FOREST

R. BURKHALTER (Laboratoire National d'Essais, Paris, France) and B. KIENTZ (Societe Francaise d'Etudes et de Recherches Economiques et Statistiques, Chambéry, France) IN: International Symposium on Remote Sensing of Environment, 18th, Paris, France, October 1-5, 1984, Proceedings. Volume 3. Ann Arbor, MI, Environmental Research Institute of Michigan, 1985, p. 1489-1495. Research supported by Ministère de l'Environnement, Federation Departementale des Chasseurs, Office National de la Chasse and Office National des Forets.

A counting operation of big game by aerial thermography was done between February 14th and 19th, 1983 on 28,000 hectares, in the Arc-en-Barrois forest of Eastern France. A soie analogic scanner operating between 10 and 12 microns was used for this study. The flight line was maintained through the use of a radar location system. The animals were inventoried by visual

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interpretation of 70 mm film data. 613 roebucks, 428 wild boar and 881 stags were counted. These results compared favorably with those obtained through traditional means of counting. Aerial thermography appears today as an operational tool for counting big game in deciduous forests in relatively flat areas. Author

A86-21229#

CROP IDENTIFICATION AND AREA ESTIMATION - AN APPROACH TO EVALUATE ARGENTINE MAIN CROP AREAS USING LANDSAT DATA

F. V. REDONDO, C. LAC PRUGENT, C. GARGANTINI, and M. ANTES (Comision Nacional de Investigaciones Espaciales, Centro de Sensores Remotos, Buenos Aires, Argentina) IN: International Symposium on Remote Sensing of Environment, 18th, Paris, France, October 1-5, 1984, Proceedings. Volume 3. Ann Arbor, MI, Environmental Research Institute of Michigan, 1985, p. 1541-1549. refs

A combined use of ground and Landsat data is proposed in order to be able to estimate crop hectareage(wheat) in large areas using the satellite as a qualified enumerator. The method, based on a random sampling design on a stratified frame, defines a set of samples for which ground(n) and Landsat data is gathered and where the remaining samples segments are surveyed through satellite data(n'). The n set of data is used to estimate the accuracy of crop identification and to develop the regression estimates for the final estimation. The pilot experience here presented showed satisfactory results and a second phase of the study is being conducted. An optimum ratio n'/n will allow to get maximum efficiency/profit of the satellite aid system for crop estimation.

Author

A86-21230#

THE VALUE OF DIRECT OBSERVATIONS OF CROP CANOPIES FOR INDICATING GROWING CONDITIONS AND YIELD

C. L. WIEGAND (USDA, Agricultural Research Service, Weslaco, TX) IN: International Symposium on Remote Sensing of Environment, 18th, Paris, France, October 1-5, 1984, Proceedings. Volume 3. Ann Arbor, MI, Environmental Research Institute of Michigan, 1985, p. 1551-1560. refs

Agrometeorological crop growth/yield models are being developed that express the response of specific crops to their soil and aerial environments. Spectral observations that might serve either as (1) inputs or 'drivers' of such models, or (2) independent feedback to reset or override the simulations are discussed and illustrated. Candidate spectral inputs include canopy temperature (in lieu of air temperature); vegetation indices as spectral surrogates of leaf area index and phytomass; seasonal vegetation index curves (spectral profiles) that contain information on growth rate, canopy senescence rate, and magnitude and duration of canopy greenness; and, light absorption estimates. The direct look at the canopies provided by sensors, e.g., those aboard the polar orbiting environmental satellites, Spot or Landsat-4 and -5, and expressed as vegetation indices are demonstrated to provide checks on canopy condition and yield. It is concluded that the vegetation indices capture information on canopy development and condition; respond to management and soil profile differences among fields that are not easily included in agrometeorological models; and, provide a means of quantifying canopy development in response to stresses. Thus there is merit in further developing spectral parameters for use in agrometeorological models. Author

A86-21231#

IDENTIFICATION AND MAPPING OF RICE PADDY IN SOUTHERN THAILAND USING SPACEBORNE IMAGING RADAR - PROBLEMS AND PROSPECTS

A. LIND (Vermont, University, Burlington) IN: International Symposium on Remote Sensing of Environment, 18th, Paris, France, October 1-5, 1984, Proceedings. Volume 3. Ann Arbor, MI, Environmental Research Institute of Michigan, 1985, p. 1561-1569.

The use of L Band (23-cm) spaceborne radar data offers a potential solution to the problem of cloudiness in identifying and mapping rice lands in the wet, coastal lowlands of southern

Thailand and on coastal barriers and alluvial plains. SIR-A radar imagery is investigated with a view toward identifying and mapping rice growing areas distributed among the coastal barrier and alluvial plain environments. The SIR-A imagery from orbit 30, obtained on November 13, 1981, was used for the investigation, and both visual and computer techniques were used, including enhancements by linear and Gaussian histogram stretching. Problems are noted along the coastal barrier where extremely high returns (from wet leaves of sugar palms bordering the paddies) mask the presence of flooded rice fields. D.H.

A86-21232#

SKYEYE - AN OPERATIONAL SYSTEM FOR CROP CONDITION MONITORING FROM LANDSAT IMAGES

M. KVARNSTROM, A. SODERMAN, and T. WESTIN (Satellite Image in Kiruna Corp., Kiruna, Sweden) IN: International Symposium on Remote Sensing of Environment, 18th, Paris, France, October 1-5, 1984, Proceedings. Volume 3. Ann Arbor, MI, Environmental Research Institute of Michigan, 1985, p. 1571-1575.

Requirements are considered for an operational system that can assess crop conditions by using different combinations of sensors and image processing techniques. Such a system must be fast enough to give up-to-date information and it must cover large areas at a reasonable cost. Such a system has been developed and operational since 1983; called Skyeeye, it covers Europe and the U.S.S.R. west of the Aral Sea. By using only Landsat data from bands 5 and 7, and degrading the ground resolution to 240 by 240 meters, it has been possible to use quick-look CCTs and thereby sharply lower the cost for data. The proximity of the Satellite Image Corporation to the Landsat receiving station at Esrange permits same-day analysis of the data and ensures timeliness for the users. D.H.

A86-21233#

EFFECTIVE INTEGRATION OF DATA SOURCES FOR OPTIMIZING RESOURCE INVENTORIES

N. E. G. ROLLER (Michigan, Environmental Research Institute, Ann Arbor) IN: International Symposium on Remote Sensing of Environment, 18th, Paris, France, October 1-5, 1984, Proceedings. Volume 3. Ann Arbor, MI, Environmental Research Institute of Michigan, 1985, p. 1577-1603. refs

This paper describes methods for optimally integrating a variety of sources of resource description data into inventory procedures so that the resulting inventories are more accurate and useable by resource planners and managers. Several new sources of remote sensing data are described, and the considerations associated with selecting the proper combination of available data sources to meet the objectives of a resource inventory are discussed. Next, the issues involved in successfully integrating a combination of data sources into an optimal inventory procedure are described. The differences between map-based and statistically-based procedures are reviewed, and effective inventory procedures for both approaches are presented. Examples of properly integrated resource inventories are provided to illustrate the practical application of many of the methods described. Author

A86-21244#

CONTRIBUTION OF LANDSAT DATA TO MAPPING OF LAND RESOURCES IN ARID REGIONS - 'TATAHOUINE' AND 'ZARZIS' SHEETS OF 1/200,000 SOIL MAP OF TUNISIA

M. POUGET, B. LORTIC (Office de la Recherche Scientifique et Technique d'Outre Mer, Bureau de Teledetection, Bondy, France), A. SOUSSI (Direction des Sols, Tunis, Tunisia), R. ESCADAFAL (Mission ORSTOM, Gabes, Tunisia), and A. MTIMET (Direction des Sols, Gabes, Tunisia) IN: International Symposium on Remote Sensing of Environment, 18th, Paris, France, October 1-5, 1984, Proceedings. Volume 3. Ann Arbor, MI, Environmental Research Institute of Michigan, 1985, p. 1717-1725. refs

In the area studied, spectral brightness (MSS Landsat 1-3) depends basically on the characters of the soil surfaces, particularly roughness (stoniness, crusting) and color, which is also closely

connected with soil texture. Using an approach which closely combines field and laboratory work, a multispectral classification makes it possible to analyse the MSS data structure and to obtain a computerized map of soil surface conditions. Taking field observations into account, i.e., relationships between soils and soil surfaces, this document was interpreted for drawing up morphological map units. In the next step, several derived thematic maps can be obtained, for example: the land resources map (scale: 1/200,000). Author

A86-21247#**A PROCEDURE FOR THE EXTRACTION OF VEGETATION INFORMATION FROM NOAA AVHRR DATA**

J. A. HOWARD, M. LORENZINI, and A. ZANDONELLA (UN, Food and Agriculture Organization, Rome, Italy) IN: International Symposium on Remote Sensing of Environment, 18th, Paris, France, October 1-5, 1984, Proceedings. Volume 3. Ann Arbor, MI, Environmental Research Institute of Michigan, 1985, p. 1743-1750. refs

A procedure is presented for extracting from AVHRR data new features of interest for vegetation studies. Approach used consists in projecting AVHRR data, of selected channel pairs, in a standardized feature space and in selecting, in this space, the axes more representative of physical scene characteristics in relation to the position of centroids of the classes. Features extracted are related to vegetal greenness, soil conditions in terms of brightness and wetness and allotropic forms of water. Author

A86-21254#**EVALUATION AND USE OF SATELLITE PRODUCTS FOR AGRICULTURAL ASSESSMENTS**

S. K. LEDUC (DOC, NOAA, National Environmental Satellite Data and Information Service, Columbia, MO) IN: International Symposium on Remote Sensing of Environment, 18th, Paris, France, October 1-5, 1984, Proceedings. Volume 3. Ann Arbor, MI, Environmental Research Institute of Michigan, 1985, p. 1815-1820. refs

Satellite derived products are being evaluated and used to provide input to the agricultural assessment process in the U.S. and for other regions around the world. Vegetative growth and development are dependent on solar radiation. Solar radiation on the ground is estimated from the Geostationary Operational Environmental Satellite (GOES) data for the Western Hemisphere. These data were statistically compared to ground measurements of insolation. A vegetation index derived from the NOAA-7 polar orbiting satellite has been evaluated for assessment of vegetative conditions around the world. To help establish the deterministic component in the time series of the vegetation index, weighted averages based on land use have been developed. D.H.

A86-21255#**A CONTINUING DEVELOPMENT OF AN APPLICATION FOR LANDSAT DATA 1983 DCLC WINTER WHEAT ACREAGE ESTIMATES FOR FOUR STATES**

P. W. COOK, G. MAY, and R. A. KESTLE (USDA, Washington, DC) IN: International Symposium on Remote Sensing of Environment, 18th, Paris, France, October 1-5, 1984, Proceedings. Volume 3. Ann Arbor, MI, Environmental Research Institute of Michigan, 1985, p. 1821-1833. refs

A86-21258#**MAPPING AND EVALUATION OF ABOVE-GROUND PHYTO MASS - APPLICATION TO PERMANENT PASTURES**

C. M. GIRARD (Paris-Girgnon, Institut National Agronomique, Thiverval-Grignon, France) IN: International Symposium on Remote Sensing of Environment, 18th, Paris, France, October 1-5, 1984, Proceedings. Volume 3. Ann Arbor, MI, Environmental Research Institute of Michigan, 1985, p. 1855-1861.

The author gives the results of an experiment combining IRC aerial photographs, in the field observations and measurements, SPOT simulation data, and Landsat data. It shows that mapping and evaluation of permanent pastures and their instantaneous above-ground phytomass is possible. Author

A86-21259#**FOREST DAMAGE ASSESSMENT VIA ADVANCED IMAGE PROCESSING TECHNIQUES BASED ON TM-COMPATIBLE AIRBORNE SCANNER DATA**

H. KAUFMANN, J. HENKEL, R. HAYDN, and B. KOCH (Muenchen, Universitaet, Munich, West Germany) IN: International Symposium on Remote Sensing of Environment, 18th, Paris, France, October 1-5, 1984, Proceedings. Volume 3. Ann Arbor, MI, Environmental Research Institute of Michigan, 1985, p. 1863-1871. refs

A means of inventorying and monitoring damage to forests by disease, using a Bendix M-squared-S scanner, is described. Advanced image processing techniques are used to enhance the subtle differences between spruce trees damaged to different degrees, independently from such parameters as underlying vegetation, deciduous trees, shadows, etc., to improve the objectivity and accuracy of data evaluation and interpretation. D.H.

A86-21270#**TM VS. MSS IN OPERATIONAL PEATLAND INVENTORY**

S. PALA (Ministry of Natural Resources, Ontario Centre for Remote Sensing, Toronto, Canada) IN: International Symposium on Remote Sensing of Environment, 18th, Paris, France, October 1-5, 1984, Proceedings. Volume 3. Ann Arbor, MI, Environmental Research Institute of Michigan, 1985, p. 1961-1972.

A86-21271#**ANALYSIS OF MSS LANDSAT DATA FOR SMALL-SCALE SOIL SURVEYS IN THE HUMID TROPICS - TWO CASE STUDIES: KANDY AREA IN SRI LANKA AND CHANTABURI AREA IN SOUTHEAST THAILAND**

L. A. VAN SLEEN (International Institute for Aerospace Survey and Earth Sciences, Enschede, Netherlands) IN: International Symposium on Remote Sensing of Environment, 18th, Paris, France, October 1-5, 1984, Proceedings. Volume 3. Ann Arbor, MI, Environmental Research Institute of Michigan, 1985, p. 1973-1982. refs

Multispectral scanner Landsat data for small-scale soil surveys were analyzed using visual image interpretation (including fieldwork and limited aerial photo interpretation) and a number of digital image processing techniques. In the humid tropics, image interpretability of more pronounced relief, covered by evergreen vegetation, was found to depend above all on favorable solar azimuth. Flatter (often cultivated) landforms were best displayed by using a combination of wet and dry season images. Interpretability of structurally controlled relief forms could be somewhat improved by means of directional filtering techniques. D.H.

A86-21273#**REMOTE SENSING AND CROP PRODUCTION FORECASTING IN ITALY RESULTS AND FUTURE PROGRAMS**

P. C. DE ANGELIS (Ministero dell'Agricoltura delle Foreste, Ufficio Centrale di Ecologia Agraria, Rome, Italy) and S. GIZZI (Consorzio ITA, Rome, Italy) IN: International Symposium on Remote Sensing of Environment, 18th, Paris, France, October 1-5, 1984, Proceedings. Volume 3. Ann Arbor, MI, Environmental Research Institute of Michigan, 1985, p. 1993-2000.

A86-22564**TRANSFORMATION ERROR CORRELATIONS IN COMPUTER-AIDED FOREST MAPPING ON THE BASIS OF SPACE IMAGERY [SOOTNOSHENIIA DLIA OSHIBOK TRANSFORMIROVANIYA PRI AVTOMATIZIROVANNOM KARTOGRAFIROVANII LESOV PO KOSMICHESKIM SNIMKAM]**

E. D. BODASTKII, D. A. STAROSTENKO, and R. I. ELMAN (Vsesoiuznoe Aerofotolesoustroitel'noe Ob'edinenie Lesproekt, Moscow, USSR) Issledovanie Zemli iz Kosmosa (ISSN 0205-9614), Sept.-Oct. 1985, p. 99-105. In Russian. refs

A86-22647

LARGE-SCALE SAMPLING PHOTOGRAPHY FOR FOREST HABITAT-TYPE IDENTIFICATION

W. BEFORT (New Hampshire, University, Durham) Photogrammetric Engineering and Remote Sensing (ISSN 0099-1112), vol. 52, Jan. 1986, p. 101-108. refs

To learn whether or not forest sites could be classified as to ecological habitat type by use of large-scale aerial sampling photography, 156 stands in northern Idaho and eastern Washington were photographed at scales around 1:1000. A type-identification key was assembled, and five interpreters were asked to assign habitat type labels to 111 stereophoto sample strips representing 16 field-identified habitat types. A success rate of approximately 75 percent was achieved. Extreme misclassifications were rare, and interpretations were highly correlated with the positions of the types along a bioclimatic gradient. Author

A86-22837

PRELIMINARY EVALUATION OF SIMULATED SPOT DATA ACQUIRED 6 JULY, 1983, MORTON COUNTY, NORTH DAKOTA

E. S. MERRITT (Earth Satellite Corp., Chevy Chase, MD) IN: SPOT simulation applications handbook; Proceedings of the SPOT Symposium, Scottsdale, AZ, May 20-23, 1984. Falls Church, VA, American Society of Photogrammetry, 1984, p. 109-114.

Preliminary analysis of simulated SPOT satellite data taken over Morton County, North Dakota on July 6, 1983 indicates significant potential for use in assessments of global agricultural conditions. The spectral and spatial resolution of the simulated data permits the preparation of analyses of agricultural conditions, crop type, etc. at a level heretofore not possible with Landsat MSS. Separation of small grains into spring wheat, barley and oats appears to be quite feasible. Water status can be easily assessed using small farm ponds less than 50 metres in size. Drainage condition in individual small fields is readily done. Future study needs to be directed to the application of the 'real' SPOT data in an effective global system. Author

A86-22838

DISCRIMINATION OF ORCHARD AND TRUCK CROPS NEAR OXNARD, CALIFORNIA USING SPOT SIMULATOR DATA

C. T. SAILER, L. J. MANN, J. E. ESTES, D. ECKHARDT, and S. GOETZ (California, University, Santa Barbara) IN: SPOT simulation applications handbook; Proceedings of the SPOT Symposium, Scottsdale, AZ, May 20-23, 1984. Falls Church, VA, American Society of Photogrammetry, 1984, p. 115-121.

SPOT simulator data was used to evaluate the potential applicability of SPOT satellite data in the identification of cover types in agricultural lands. Procedures employed in this evaluation involved both manual and computer-assisted techniques. Computer-assisted techniques included both supervised and unsupervised procedures. Data were acquired for the Oxnard and Camarillo quadrangles Ventura County, California on June 23, 1983. The site selected for study was an area that is intensely farmed, with field sizes ranging from 1 to 74 acres, and has a highly variable planting/harvesting schedule with no existing crop calendar. This is primarily due to the climate which allows a year-round growing/planting season and to this area's rich, deep soils. Results indicate that the improved spatial resolution of this data permits a high level of mapping accuracy for manual and supervised classification procedures for a level of classification based on the Anderson et al. classification scheme. However, the temporal resolution of this sensor (26 day repeat cycle), even with increased frequency employing off-nadir viewing, is very much a research question and could be a major deterrent to the potential of SPOT data for operational use in agriculture. Author

A86-22839

AN ASSESSMENT OF SPOT SIMULATOR DATA FOR RANGELAND RESOURCE MAPPING

J. A. MASLANIK, R. A. MCKINLEY (Technicolor Government Services, Inc., Denver, CO), and W. J. BONNER, JR. (U.S. Bureau of Land Management, Denver, CO) IN: SPOT simulation applications handbook; Proceedings of the SPOT Symposium, Scottsdale, AZ, May 20-23, 1984. Falls Church, VA, American Society of Photogrammetry, 1984, p. 122-129. refs

This paper presents initial results of research Bureau of Land Management investigators have conducted to date with the simulated SPOT 20m digital data. These studies have been conducted using data collected over an area (simulation Site 32) in Northwestern Arizona. Studies included assessment of the spatial and spectral characteristics of the data, as well as comparisons with Landsat Multispectral Scanner imagery. Results indicate that the high spatial resolution of the simulated SPOT data provides significant improvements over previous range vegetation classifications developed using Landsat MSS data. In addition, the data generate more visually pleasing and interpretable results due to the characteristics of smaller pixels. Author

A86-22847

WILDLIFE HABITAT MAPPING IN LAC QUI PARLE, MINNESOTA

C. J. MERRY (U.S. Army, Cold Regions Research and Engineering Laboratory, Hanover, NH), G. GREEN, R. DEVENDORF (U.S. Army, Corps of Engineers, St. Paul, MN), and S. ANDERSON (Minnesota Land Management Information Center, St. Paul) IN: SPOT simulation applications handbook; Proceedings of the SPOT Symposium, Scottsdale, AZ, May 20-23, 1984. Falls Church, VA, American Society of Photogrammetry, 1984, p. 205-208. Army-sponsored research.

SPOT High Resolution Visible (HRV) simulated data were obtained over Lac qui Parle, Minnesota, to determine their usefulness for mapping wildlife habitat categories associated with the U.S. Army Corps of Engineers projects. Ground truth data were available from photointerpreted wildlife habitat unit maps and the agricultural crop inventory prepared for the summer of 1983. A geometric correction could not be applied to the data set, so only the spectral reflectance quality of the data was assessed. The sample size of 512 X 512 pixels was selected for the analyses. An unsupervised classification land cover map was generated with the Earth Resources Laboratory Application Software package. The classification was successful in discriminating wheat and alfalfa, and other uniformly-colored areas, but pasture and corn could not be separated. Also, no success in separation of grasslands and legumes was achieved. The results indicate that the 20-m HRV data can be used to photointerpret wildlife habitat using the false color image, but a digital classification cannot be performed. To obtain a habitat map using the HRV data would require a multitemporal analysis. Author

A86-22853

THE INTERPRETATION OF FOREST RESOURCES IN CALIFORNIA ON SIMULATED SPOT IMAGERY

S. D. DEGLORIA (California, University, Berkeley) IN: SPOT simulation applications handbook; Proceedings of the SPOT Symposium, Scottsdale, AZ, May 20-23, 1984. Falls Church, VA, American Society of Photogrammetry, 1984, p. 267-274. Research supported by the University of California. refs

Simulated SPOT data were acquired over a western mixed conifer forest site in the northern Sierra Nevada of California for assessing the utility of these data for forest and soil inventory and forest land management plan development. Data collected coincident with the SPOT data acquisition included ground and low altitude aerial photography of selected sites. A subset of 1982 vegetation-soil characterization ground plots located within the SPOT data set were also used in the analysis. Snow cover at the time of data acquisition precluded analysis of the data in the true fir timber sites above 2000 m elevation. Analysis of the 'P' site data using the combined 1:24,000 scale false color composite of 10 m panchromatic and 20 m multispectral data indicate that the

SPOT data will allow: (1) the discrimination of forest stands of differing stand densities and size classes; (2) the plotting and navigating of primary, secondary, and tertiary road networks required for field survey and timber harvesting; (3) the discrimination of contrasting soil associations based on geologic, geomorphic, pedologic, and vegetative indicators interpreted on the image products; and (4) the delineation of land units comprising sites most suitable for reforestation practices. Author

A86-23206* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.

EARLY WARNING AND CROP CONDITION ASSESSMENT RESEARCH

G. O. BOATWRIGHT and V. S. WHITEHEAD (NASA, Johnson Space Center; USDA, Agricultural Research Service, Houston, TX) IEEE Transactions on Geoscience and Remote Sensing (ISSN 0196-2892), vol. GE-24, Jan. 1986, p. 54-64. refs

The Early Warning Crop Condition Assessment Project of AgRISTARS was a multiagency and multidisciplinary effort. Its mission and objectives were centered around development and testing of remote-sensing techniques that enhance operational methodologies for global crop-condition assessments. The project developed crop stress indicators models that provide data filter and alert capabilities for monitoring global agricultural conditions. The project developed a technique for using NOAA-n satellite advanced very-high-resolution radiometer (AVHRR) data for operational crop-condition assessments. This technology was transferred to the Foreign Agricultural Service of the USDA. The project developed a U.S. Great Plains data base that contains various meteorological parameters and vegetative index numbers (VIN) derived from AVHRR satellite data. It developed cloud screening techniques and scan angle correction models for AVHRR data. It also developed technology for using remotely acquired thermal data for crop water stress indicator modeling. The project provided basic technology including spectral characteristics of soils, water, stressed and nonstressed crop and range vegetation, solar zenith angle, and atmospheric and canopy structure effects. Author

A86-23207* Minnesota Univ., St. Paul.

FIELD SPECTROSCOPY OF AGRICULTURAL CROPS

M. E. BAUER (Minnesota, University, St. Paul), C. S. T. DAUGHTRY, L. L. BIEHL (Purdue University, West Lafayette, IN), E. T. KANEMASU (Kansas State University of Agriculture and Applied Science, Manhattan), and F. G. HALL (NASA, Goddard Space Flight Center, Greenbelt, MD) IEEE Transactions on Geoscience and Remote Sensing (ISSN 0196-2892), vol. GE-24, Jan. 1986, p. 65-75. refs

The development of the full potential of multispectral data acquired from satellites, requires quantitative knowledge, and physical models of the spectral properties of specific earth surface features. Knowledge of the relationships between spectral-radiometric characteristics and important biophysical parameters of agricultural crops and soils can best be obtained by carefully controlled studies of fields or plots. It is important to select plots where data describing the agronomic-biophysical properties of the crop canopies and soil background are attainable, taking into account also the feasibility of frequent timely calibrated spectral measurements. The term 'field spectroscopy' is employed for this research. The present paper is concerned with field research which was sponsored by NASA as part of the AgRISTARS Supporting Research Project. Attention is given to field research objectives, field research instrumentation, measurement procedures, spectral-temporal profile modeling, and the effects of cultural and environmental factors on crop reflectance. G.R.

A86-23212* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.

VEGETATION ASSESSMENT USING A COMBINATION OF VISIBLE, NEAR-IR, AND THERMAL-IR AVHRR DATA

V. S. WHITEHEAD (NASA, Johnson Space Center, Houston, TX), W. R. JOHNSON, and J. A. BOATRIGHT (Lockheed Engineering and Management Services Co., Inc., Houston, TX) IEEE Transactions on Geoscience and Remote Sensing (ISSN 0196-2892), vol. GE-24, Jan. 1986, p. 107-112. refs

Twelve-hour temperature difference (thermal inertia) maps generated by rectifying and registering ascending (day) passes and descending (night) passes of the NOAA-7 Advanced Very High Resolution Radiometer (AVHRR) are compared to vegetation index maps generated from the visible and near IR data from the day pass of that satellite. There appears to be significant and unique information concerning surface characteristics in the temperature difference data on the 1-km scale of the AVHRR. A scatter diagram is provided which shows the pattern of day-night temperature difference compared to vegetation index for irrigated agriculture, dry rangeland, lakes, wet areas and burned rangeland. A detailed description of the techniques employed to provide the day-night temperature maps is provided. Author

A86-23213* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

ANALYSIS OF FOREST STRUCTURE USING THEMATIC MAPPER SIMULATOR DATA

D. L. PETERSON, W. E. WESTMAN, J. A. BRASS (NASA, Ames Research Center, Moffett Field, CA), N. J. STEPHENSON (Cornell University, Ithaca, NY), V. G. AMBROSIA, M. A. SPANNER (NASA, Ames Research Center; Technicolor Government Services, Inc., Moffett Field, CA) et al. IEEE Transactions on Geoscience and Remote Sensing (ISSN 0196-2892), vol. GE-24, Jan. 1986, p. 113-121. refs

The potential of Thematic Mapper Simulator (TMS) data for sensing forest structure information has been explored by principal components and feature selection techniques. In a survey of forest structural properties conducted for 123 field sites of the Sequoia National Park, the canopy closure could be well estimated ($r = 0.62$ to 0.69) by a variety of channel bands and band ratios, without reference to the forest type. Estimation of the basal area was less successful ($r = 0.51$ or less) on the average, but could be improved for certain forest types when data were stratified by floristic composition. To achieve such a stratification, individual sites were ordinated by a detrended correspondence analysis based on the canopy of dominant species. The analysis of forest structure in the Sequoia data suggests that total basal area can be best predicted in stands of lower density, and in younger even-aged managed stands. I.S.

A86-23214#

A CORRELATION AND REGRESSION ANALYSIS OF PERCENT CANOPY CLOSURE VERSUS TMS SPECTRAL RESPONSE FOR SELECTED FOREST SITES IN THE SAN JUAN NATIONAL FOREST, COLORADO

M. K. BUTERA (Science Applications International Corp., Washington, DC) IEEE Transactions on Geoscience and Remote Sensing (ISSN 0196-2892), vol. GE-24, Jan. 1986, p. 122-129. refs

This investigation tested the correlation of canopy closure with the signal response of individual Thematic Mapper Simulator (TMS) bands for selected forest sites in the San Juan National Forest, Colorado. Ground truth consisted of a photointerpreted determination of percent canopy closure of 0-100 percent for 32 sites. The sites selected were situated on plateaus at an elevation of approximately 3 km with slope less than or equal to 10 percent. The predominant tree species were ponderosa pine and aspen. The mean TMS response per band per site was calculated from data acquired by aircraft during mid-September, 1981. A correlation analysis of TMS response versus canopy closure resulted in the following correlation coefficients for bands 1-7, respectively: -0.757, -0.663, -0.666, -0.088, -0.797, -0.597, -0.763. Two model regressions were applied to the TMS data set to create a map of

predicted percent forest canopy closure for the study area. Results indicated percent predictive accuracies of 71, 74, and 57 for percent canopy closure classes of 0-25, 25-75, and 75-100, respectively.

Author

A86-23215*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

USE OF REMOTELY SENSED DATA FOR ASSESSING FOREST STAND CONDITIONS IN THE EASTERN UNITED STATES

D. L. WILLIAMS and R. F. NELSON (NASA, Goddard Space Flight Center, Greenbelt, MD) IEEE Transactions on Geoscience and Remote Sensing (ISSN 0196-2892), vol. GE-24, Jan. 1986, p. 130-138. refs

Techniques for the detection, classification, and measurement of forest disturbances, using digital Landsat data for three study areas (Pennsylvania, North Carolina, and Maine) are reported. Results with respect to (1) the delineation and assessment of forest damage due to the use of two forest insect defoliators, and (2) qualitative assessment of the Multispectral Scanner (MSS) and the Thematic Mapper data for delineating forest stand characteristics are presented. Key results include a development of a statewide MSS digital data base and associated image-processing techniques for accurately delineating insect-damaged and healthy forest areas. For classification of broad land-cover classes which are spectrally homogeneous, the accuracy yielded by the use of either MSS data or TM Simulator data is similar. However, the TMS data provided 20 percent accuracy improvement over the MSS results when detailed (Level III) forest classes were mapped.

I.S.

A86-24310

MEASUREMENT OF ECOLOGICAL DESERTIFICATION TRENDS ON SEQUENTIAL REMOTE-SENSING PHOTOGRAPHS [IZMERENIE EKOLOGICHESKOI TENDENTSI OPUSTYNIVANIYA PO POVTORNYM AEROKOSMICHESKIM SNIMKAM]

B. V. VINOGRADOV, V. V. LEBEDEV, K. N. KULIK, and A. N. KAPTSOV (AN SSSR, Institut Evoliutsionnoi Morfologii i Ekologii Zhivotnykh, Moscow, USSR; Tsentr Podgotovki Kosmonavtov, USSR; Vsesoiuznyi Nauchno-Issledovatel'skii Agrolesomeliativnyi Institut, Volgograd, USSR) Akademiia Nauk SSSR, Doklady (ISSN 0002-3264), vol. 285, no. 5, 1985, p. 1269-1272. In Russian. refs

The possibility of using sequential remote-sensing photographs to study ecological desertification trends is demonstrated on a quantitative study of the dynamics of the desert-pasture ecosystem of the black lands of the Kalmytskaia ASSR, one of the largest examples of a desertification locus in the USSR. The method developed makes possible the mathematical expression of the desertification trend and the extrapolation of the trend over a period of 8-16 years.

B.J.

A86-25479

INTERPRETATION OF THE SOIL COVER OF NONCHERNOZEM AREAS ON DIFFERENT TYPES OF SPACE PHOTOGRAPHS IN CONNECTION WITH THE COMPILATION OF SMALL-SCALE SOIL MAPS [DESHIFIROVANIE POCHVENNOGO POKROVA NECHERNOZEM'IA NA KOSMICHESKIKH FOTOSNIMKAKH RAZNYKH TIPOV PRI SOSTAVLENII MELKOMASSTABNYKH POCHVENNYKH KART]

M. S. SIMAKOVA (Pochvennyi Institut, Moscow, USSR) Issledovanie Zemli iz Kosmosa (ISSN 0205-9614), Nov.-Dec. 1985, p. 22-27. In Russian.

Space photographs of several scales and types (black and white composite, multispectral, and color band-selective) for nonchernozem areas are interpreted in terms of soil cover. A morphometric analysis of mesorelief forms, based on medium-scale topographic maps and aerial photographs, is used to select optimal scales and types of photographs for the compilation of small-scale soil maps.

B.J.

A86-25481

POSSIBILITY OF THE REMOTE LASER DETERMINATION OF THE CONDITION OF AGRICULTURAL CROPS ACCORDING TO THEIR LUMINESCENCE CHARACTERISTICS [O VOZMOZHNOСТИ DISTANTSIONNOI LAZERNOI DIAGNOSTIKI SOSTOYANIYA SEL'SKOKHOZIAISTVENNYKH KULTUR PO IKH LIUMINESTSENTNYM KHARAKTERISTIKAM]

V. A. KANEVSKII, V. F. RIAZANTSEV, O. N. PEREKREST, V. P. ILIN, IA. I. MOVCHAN (AN USSR, Institut Botaniki, Kiev, Ukrainian SSR; AN MSSR, Tsentr Avtomatizatsii Nauchnykh Issledovaniy i Metrologii, Kishinev, Moldavian SSR) et al. Issledovanie Zemli iz Kosmosa (ISSN 0205-9614), Nov.-Dec. 1985, p. 37-39. In Russian.

The luminescence intensities of crop fields have been remotely measured using a helicopter-borne laser. The data reveal the dependence of the ratio of luminescences measured at 685 and 735 nm on the fertilizer application rate, the amount of chlorophyll, and the dry biomass of the vegetation.

B.J.

A86-26225* Delaware Univ., Newark.

THE USE OF AIRBORNE IMAGING SPECTROMETER (AIS) DATA TO DIFFERENTIATE MARSH VEGETATION

M. F. GROSS and V. KLEMAS (Delaware, University, Newark) Remote Sensing of Environment (ISSN 0034-4257), vol. 19, Feb. 1986, p. 97-103. Research supported by the University of Delaware and NASA. refs

The Airborne Imaging Spectrometer (AIS) is a high spectral resolution (9.6-nm-wide bands between 0.9 and 2.4 microns) instrument. Analysis of AIS data revealed significant differences in characteristics of the spectral radiance curves of four types of wetland vegetation canopies (trees, broadleaf herbaceous, *Spartina alterniflora*, and *S. patens*/*Distichlis spicata*) in Delaware, enabling them to be distinguished. The single most useful spectral region was that between 1.40 and 1.90 microns. Differences in radiance values at various wavelengths between samples of the same vegetation type could potentially be used to estimate biomass. Thus, high spectral resolution spectrometry appears to have significant value for remote sensing studies of wetland vegetation.

Author

A86-26695

SEASONAL CONSISTENCY OF SALT-MARSH VEGETATION CLASSES CLASSIFIED FROM LARGE-SCALE COLOR INFRARED AERIAL PHOTOGRAPHS

P. E. R. DALE, K. HULSMAN, and A. L. CHANDICA (Griffith University, Nathan, Australia) Photogrammetric Engineering and Remote Sensing (ISSN 0099-1112), vol. 52, Feb. 1986, p. 243-250. Research supported by Griffith University and Gold Coast City Council. refs

CIR aerial photographs taken over a south-east Queensland salt-marsh in autumn and spring were enlarged to a scale of 1:1100. Print reflectances at sample sites - calculated from measurements through the neutral, blue, green, and red filters of a densitometer - were used as attributes in a divisive clustering procedure. The classes generated were compared in terms of their site membership, discriminating attributes, and relationship with vegetation data from field sampling. Although reflectances varied seasonally, the classification results were similar for each season and the vegetation characteristics corresponded well to the classes generated. The greatest seasonal differences occurred in reflectance through the red and blue filters, representing the infrared and green spectral bands. The photographs taken in autumn, with high red reflectances, provided maximum discrimination between the classes.

Author

A86-29404

VIDEO DIGITIZATION OF AERIAL PHOTOGRAPHS FOR MEASUREMENT OF WIND EROSION DAMAGE ON CONVERTED RANGELAND

J. G. LYON, J. T. HEINEN (Ohio State University, Columbus), and J. F. MCCARTHY (Northern Arizona University, Flagstaff, AZ) Photogrammetric Engineering and Remote Sensing (ISSN 0099-1112), vol. 52, March 1986, p. 373-377. refs

This project developed a practical approach for measuring the area of wind erosion damage on rangeland converted to farmland. The selected study area consisted of 7,150 ha that was rangeland before 1954. A video graphics microcomputer system enhanced and digitized aerial photographs to measure the area of wind erosion or blowouts and the proportion of cotton cover crop on the selected farms. The result was that 23 percent of the total study area showed signs of wind erosion damage. Author

A86-29405

ALPINE VEGETATION CLASSIFICATION USING HIGH RESOLUTION AERIAL IMAGERY AND TOPOCLIMATIC INDEX VALUES

T. D. FRANK and S. A. ISARD (Illinois, University, Urbana) Photogrammetric Engineering and Remote Sensing (ISSN 0099-1112), vol. 52, March 1986, p. 381-388. refs

Topoclimatic index values, representing the primary direct determinants of vegetation distribution in the mid-latitude alpine tundra, are combined with film density data from a color infrared aerial photograph to numerically derive a vegetation map of the Saddle area on Niwot Ridge, Colorado. Film density is used to distinguish between moist or wet vegetation that receives a continuous supply of meltwater and dry vegetation types that rely on precipitation water input. Topoclimatic index values represent (1) the effect of slope-aspect in relation to prevailing wind direction on snow accumulation and (2) the effect of isolation on evapotranspiration and, consequently, soil moisture status. The vegetation classification reveals that combining topoclimatic and film density data produces an alpine map of high categorical accuracy. Author

A86-29407

EVALUATION OF THE EFFECTS OF PHOTO MEASUREMENT ERRORS ON PREDICTIONS OF STAND VOLUME FROM AERIAL PHOTOGRAPHY

J. L. SMITH (Virginia Polytechnic Institute and State University, Blacksburg) Photogrammetric Engineering and Remote Sensing (ISSN 0099-1112), vol. 52, March 1986, p. 401-410. refs

A simple and flexible technique was developed for assessing the impact of photo measurement errors on aerial-photo-based volume predictions. The method utilizes random numbers from distributions as substitutes for actual measurement errors, and thus is able to handle errors of many types and sizes without making restrictive assumptions. The procedure allows the user to examine the properties of the fitted models that are of interest. The proposed technique is demonstrated on Southern pine and Douglas-fir data sets. Author

N86-16688*# Pennsylvania State Univ., University Park. Office for Remote Sensing of Earth Resources.

DEVELOPMENT OF COMPUTER SOFTWARE TO ANALYZE ENTIRE LANDSAT SCENES AND TO SUMMARIZE CLASSIFICATION RESULTS OF VARIABLE-SIZE POLYGONS Final Report

B. J. TURNER, Principal Investigator, G. M. BAUMER, W. L. MYERS, and S. G. SYKES May 1981 29 p refs Original contains imagery. Original photographs may be purchased from the EROS Data Center, Sioux Falls, S.D. 57198 ERTS (Contract NAS5-26166)

(E86-10020; NASA-CR-177826; NAS 1.26:177826; PSU-IRLWR-RP-106/OR) Avail: NTIS HC A03/MF A01 CSCL 08B

The Forest Pest Management Division (FPMD) of the Pennsylvania Bureau of Forestry has the responsibility for conducting annual surveys of the State's forest lands to accurately

detect, map, and appraise forest insect infestations. A standardized, timely, and cost-effective method of accurately surveying forests and their condition should enhance the probability of suppressing infestations. The repetitive and synoptic coverage provided by LANDSAT (formerly ERTS) makes such satellite-derived data potentially attractive as a survey medium for monitoring forest insect damage over large areas. Forest Pest Management Division personnel have expressed keen interest in LANDSAT data and have informally cooperated with NASA/Goddard Space Flight Center (GSFC) since 1976 in the development of techniques to facilitate their use. The results of this work indicate that it may be feasible to use LANDSAT digital data to conduct annual surveys of insect defoliation of hardwood forests. Author

N86-16694*# Environmental Research Inst. of Michigan, Ann Arbor. Infrared and Optics Div.

COMPARISON OF THE INFORMATION CONTENTS OF LANDSAT TM AND MSS DATA

W. A. MALILA *In its Study on Spectral/Radiometric Characteristics of the Thematic Mapper for Land Use Applications* p 39-48 Sep. 1985 refs Repr. from Photogrammetric Engineering and Remote Sensing, v. 51, no. 9, Sep. 1985 p 1449-1457 Previously announced in IAA as A85-47822 ERTS Avail: NTIS HC A04/MF A01 CSCL 08B

A communications-theory approach is taken to analyze the dispersion and concentration of signal values in various data spaces, irrespective of specific class membership. Entropy is used to quantify information, and mutual information is used to measure the information represented by subsets of spectral variables. Several different comparisons of information content are made. These include comparisons of system design capacities, of data volumes occupied by agricultural data in the spaces defined by original bands and by transformed spectral (Tasseled Cap) variables, of the information contents of original bands and Tasseled Cap variables, and of the information contents of TM and MSS for the given agricultural data sets. Also, the effects of sample size, scene content, and quantization level are examined. Author

N86-16700# South Carolina Univ., Columbia. Dept. of Geography.

REMOTE SENSING FOREST BIOMASS FOR LOBLOLLY PINE USING HIGH RESOLUTION AIRBORNE SENSOR DATA

J. R. JENSEN, M. E. HODGSON, and H. E. MACKEY, JR. 1985 30 p refs Presented at the Forest Land Applications Symposium, Seattle, Wash., 25 Jun. 1985 Prepared in cooperation with Du Pont de Nemours (E. I.) and Co., Aiken, S.C. (Contract DE-AC09-76SR-00001)

(DE85-017058; DP-MS-85-62; CONF-8506167-2) Avail: NTIS HC A03/MF A01

The amount and spatial distribution of vegetation are important parameters useful in agriculture, forestry, wetland, and hydrologic research. Such data may be collected in situ by harvesting a sample of the vegetation and determining the amount of biological matter. This approach provides single point estimates which are expensive to collect and difficult to extend through space in order to map the geographic distribution of biomass. It is, however, possible in certain instances to obtain acceptable estimates of biomass by analyzing remotely sensed data. This paper describes the analysis of very high resolution, remotely sensed data of loblolly pine (*Pinus taeda*) in a controlled experiment in South Carolina. Loblolly pine was examined because it represents over 70% of the commercial forest in the southeastern United States. Pine plots located on both sandy and clay soils were treated with sewage sludge to provide 0, 445, or 890 kg of nitrogen per hectare. Indices of biomass from remote sensing data were significantly correlated with in situ biomass measurements made in each plot. A ratio of infrared (0.9 to 1.1 micron m) and red (0.65 to 0.70 micron m) channels yielded the best correlation between the remote sensing data and the in situ biomass measurements. In addition, remote sensing provided a quantitative map of the spatial distribution of the biomass in the forest plots. The indices of biomass from the

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remote sensing data were not sensitive to differences in soil type (sandy or clay).
DOE

N86-16701# South Carolina Univ., Columbia. Dept. of Geography.

REMOTE SENSING INLAND WETLANDS: A MULTISPECTRAL APPROACH

J. R. JENSEN, M. E. HODGSON, E. CHRISTENSEN, H. E. MACKEY, JR., L. R. TINNEY, and R. SHARITZ 1985 36 p refs Prepared in cooperation with Du Pont de Nemours (E.I.) and Co., Aiken, S.C. and Edgerton, Germeshausen and Grier, Inc., Las Vegas, Nev.

(Contract DE-AC09-76SR-00001)

(DE85-017060; DP-MS-85-68) Avail: NTIS HC A03/MF A01

Airborne Multispectral Scanner (MSS) data, large-scale aerial photography, and LANDSAT MSS and Thematic Mapper (TM) data is used to map a variety of wetland conditions along the Savannah River watershed in South Carolina. Predawn thermal infrared MSS imagery is analyzed to map the spatial distribution and migration of thermal effluent entering a portion of the Savannah River floodplain and the Savannah River below Augusta, Georgia. Daytime airborne MSS data are used to classify specific wetland vegetation types and associate them with their apparent (remotely sensed) temperature. Large scale, multiple data aerial photography are ideally suited to follow the growth of vegetational changes associated with the thermal discharges into the floodplain. LANDSAT MSS imagery obtained in the spring is used effectively to map the entire Savannah River watershed. LANDSAT TM imagery obtained in the summer is of limited use in regional wetland mapping.
DOE

N86-17609# Wageningen Agricultural Univ. (Netherlands). Soil Survey Inst.

THE 1984 L-BAND RADAR EXPERIMENT. PART 1: GROUND TRUTH FLEVO (NETHERLANDS) 1984 M.S. Thesis

L. STROOSNIJDER, J. STOLP, and G. G. LEMOINE 1984 86 p refs Original contains color illustrations

Avail: NTIS HC A05/MF A01

Ground truth of a polder area (7000 ha) was established for the SIR-B radar (which failed due to technical problems). A 10 km long light track of an airborne L-band scatterometer located diagonally over the test area is analyzed, resulting in soil moisture, surface roughness, and vegetation data. Data for 15 fields are determined as field averages of areas of 25 ha and may be considered representative for the 75 ha large fields. Analysis of the spatial dependency of soil moisture content, and the statistical accuracy of its determination, shows that 9 samples, distributed in a regular grid, produce a sufficiently accurate mean value over the 25 ha on each field.
Author (ESA)

N86-17825# Hunting Geology and Geophysics Ltd., Boreham Wood (England).

STUDY OF A LAND USE OF SYNTHETIC APERTURE RADAR, EXECUTIVE SUMMARY

Paris ESA Sep. 1984 13 p 2 Vol.

(Contract ESTEC-5778/83/NL-MS)

(ESA-CR(P)-2067-VOL-1) Avail: NTIS HC A02/MF A01

Characteristics of a SAR satellite and data interpretation system for land-use monitoring in Europe were investigated. Empirical data and surface and volume scattering theories do not allow clear definition of satellite parameters, due to lack of comprehensive datasets. Human and computer analysis are compared. Computer implementation of surface scattering models and a volume scattering model is described, and results of parametric and time-development studies are presented. User-defined requirements for a land use SAR are described. Criteria for manual interpretation of images are defined. Machine measures of texture are applied to SAR 580 data. Results indicate that human and machine estimates of texture differ because of speckle and that for crops, texture measures provide no more information than the mean backscatter. Image comparisons based on color compositing of smoothed and unsmoothed images are described, and the

effects of filters compared. The methods are applied to multifrequency and multitemporal data.
Author (ESA)

N86-17826# Hunting Geology and Geophysics Ltd., Boreham Wood (England).

STUDY OF A LAND USE OF SYNTHETIC APERTURE RADAR. VOLUME 1: MAIN REPORT Final Report

Paris ESA Sep. 1984 196 p refs 2 Vol.

(Contract ESTEC-5778/83/NL-MS)

(ESA-CR(P)-2067-VOL-2) Avail: NTIS HC A09/MF A01

Characteristics of a SAR satellite and data interpretation system for land-use monitoring in Europe were investigated. Empirical data and surface and volume scattering theories do not allow clear definition of satellite parameters, due to lack of comprehensive datasets. Human and computer analysis are compared. Computer implementation of surface scattering models and a volume scattering model is described, and results of parametric and time-development studies are presented. User-defined requirements for a land use SAR are described. Criteria for manual interpretation of images are defined. Machine measures of texture are applied to SAR 580 data. Results indicate that human and machine estimates of texture differ because of speckle and that for crops, texture measures provide no more information than the mean backscatter. Image comparisons based on color compositing of smoothed and unsmoothed images are described, and the effects of filters compared. The methods are applied to multifrequency and multitemporal data.
Author (ESA)

N86-18354# Marconi Co. Ltd., Chelmsford (England).

THE DEVELOPMENT OF AUTOMATIC METHODS FOR HANDLING SAR IMAGES OVER LAND

S. QUEGAN, N. J. VECK, A. WRIGHT, D. CRUSE, and J. SKINGLEY In ESA Proceedings of EARSeL/ESA Symposium on European Remote Sensing Opportunities: Systems, Sensors, and Applications p 23-29 Jun. 1985 refs Sponsored by ESA

Avail: NTIS HC A12/MF A01

Aspects of image handling relevant to a SAR producing images over land, particularly for monitoring agriculture and forestry, are discussed. Identification of ground cover type (classification); change detection; and change interpretation are considered. Segment-growing methods, algorithm performance, and thin line detection as part of the segmentation process are treated. After segmentation, shape and texture of segments can be measured. Work on the former and a comparison of man and machine perceptions of texture are described. Registration requires feature extraction, and results indicate that automatic correlation methods appear viable for speckled images. Calibration, classification, and interpretation of change require more experimental data, and merging of data from sources apart from the SAR.
Author (ESA)

N86-18766*# Purdue Univ., West Lafayette, Ind. Lab. for Applications of Remote Sensing.

CHARACTERIZATION OF VEGETATION BY MICROWAVE AND OPTICAL REMOTE SENSING Semiannual Status Report, Aug. 1985 - Jan. 1986

C. S. T. DAUGHTRY, Principal Investigator, K. J. RANSON, and L. L. BIEHL Jan. 1986 15 p refs ERTS

(Contract NAGW-799)

(E86-10012; NASA-CR-176405; NAS 1.26:176405) Avail: NTIS

HC A02/MF A01 CSCL 02C

Two series of carefully controlled experiments were conducted. First, plots of important crops (corn, soybeans, and sorghum), prairie grasses (big bluestem, switchgrass, tall fescue, orchardgrass, brome grass), and forage legumes (alfalfa, red clover, and crown vetch) were manipulated to produce wide ranges of phytomass, leaf area index, and canopy architecture. Second, coniferous forest canopies were simulated using small balsam fir trees grown in large pots of soil and arranged systematically on a large (5 m) platform. Rotating the platform produced many new canopies for frequency and spatial averaging of the backscatter signal. In both series of experiments, backscatter of 5.0 GHz (C-Band) was measured as a function of view angle and polarization. Biophysical

measurements included leaf area index, fresh and dry phytomass, water content of canopy elements, canopy height, and soil roughness and moisture content. For a subset of the above plots, additional measurements were acquired to exercise microwave backscatter models. These measurements included size and shape of leaves, stems, and fruit and the probability density function of leaf and stem angles. The relationships of the backscattering coefficients and the biophysical properties of the canopies were evaluated using statistical correlations, analysis of variance, and regression analysis. Results from the corn density and balsam fir experiments are discussed and analyses of data from the other experiments are summarized. M.G.

N86-19755# National Aeronautical Establishment, Ottawa (Ontario).

A FIELD STUDY OF GROUND DEPOSITION, WIND DRIFT AND BYSTANDER EXPOSURE FROM AGRICULTURAL AIRCRAFT SPRAY EMISSIONS

R. S. CRABBE and M. MCCOOEY Jul. 1985 42 p
(AD-A160891; NAE-AN-30; NRC-24745) Avail: NTIS HC A03/MF A01 CSCL 02A

Wind drift, deposition and bystander exposure measurements from agricultural aircraft and ground-rig spray emissions over rural terrain using conventional spray booms and atomizers are presented. A single line was treated. The formulations were aqueous oil emulsions to simulate herbicide applications and aqueous wettable powder emulsions to represent fungicide sprays. Meteorological conditions varied from calm thermally unstable to near-neutral moderately windy (4.9 ms⁻¹ at 4 m above ground). Time-integrated atmospheric droplet concentrations (dosage) were measured at breathing height to 500 m downwind and vertically to drift cloud top at 200 and 500 m downwind. Analysis of field data disclosed initial ground deposit accounting for nearly 100% of the nonvolatiles in the ground-rig emission, but only from 60 to 80% of the aircraft emission depending upon wind speed, in agreement with published data. When transformed into the equivalent operational multi-swath crosswind incremental spray scenario, the data indicated bystander dermal exposures to nonvolatiles at 75 m downwind increasing from 150 microgram for the first swath to 600 microgram after 10 swaths in light winds (2.8 ms⁻¹ at 4 m agl). At 200 m the measured drift cloud mass from the aircraft sprays varied from 1 to 2% of the emission in light winds. In this connection, 90 deg nozzle orientation on the aircraft resulted in greater wind drift than trailing orientation. The wettable-powder drift data revealed that at and beyond 75 m where spray evaporation was essentially complete, the dermal exposure could be less than from herbicide sprays due to the possibility of particle rebound from collecting surfaces. GRA

N86-20239# Joint Publications Research Service, Arlington, Va. **VARIABILITY OF COLOR COORDINATES OF SOME SOILS ACCORDING TO AIRCRAFT MEASUREMENT DATA Abstract Only**

K. Y. KONDRATYEV, V. V. KOZODEROV, P. P. FEDCHENKO, S. M. SOMOVA, and L. B. KARVOVSKAYA *In its* USSR Report: Space (JPRS-USP-86-001) p 137-138 13 Jan. 1986 Transl. into ENGLISH from Issledovaniye Zemli iz Kosmosa (Moscow, USSR), no. 2, Mar. - Apr. 1985 p 29-40
Avail: NTIS HC A03

A method for measuring the humus content in agricultural soils is described. In this method an aircraft carries a spectrometer used in measuring the spectral brightness coefficients (SBC) in the visible wavelength region which are then used in computing color coordinates quantitatively characterizing the humus content. Then the quantity of humus in soils is computed using a preconstructed calibration curve. Three types of soils were involved in this study: soddy-podzolic, gray forest and chernozem, located in a number of oblasts. Observations were made along measurement lines situated approximately 50 km apart for which SBC measurements were made. The spectral reflection curves were used in computing the color coordinates and determining the humus content at the measurement points. Observations were made from an AN-2 aircraft from a mean altitude of 100 m;

measurements were made at a solar altitude greater than 40 deg. Photometric measurements of all the investigated soils were made twice (1973 and 1981). The analyzed data revealed that aircraft spectrophotometric measurements can be used successfully in studying the dynamics of soil humus content. However, the method is suitable only for chernozems and possibly gray forest soils. Author

N86-20240# Joint Publications Research Service, Arlington, Va. **EXPERIENCE IN MAPPING EARTH ON BASIS OF SPACE PHOTOINFORMATION Abstract Only**

L. N. KULESHOV *In its* USSR Report: Space (JPRS-USP-86-001) p 138 13 Jan. 1986 Transl. into ENGLISH from Issledovaniye Zemli iz Kosmosa (Moscow, USSR), no. 2, Mar. - Apr. 1985 p 41-44
Original language document was announced in IAA as A85-37117

Avail: NTIS HC A03

The use of photographic images obtained in space to compile large scale (1:500,000) thematic maps of agricultural land in the Kalmyk territory of the USSR is evaluated. It is shown that the information content of space images may vary according to the type of map being compiled: for maps of the topographical features and uses of agricultural land, 70 percent of the data extracted from space images was useful; for maps of soil types, only 40 percent of the photographic information data was useful.

I.H. (IAA)

N86-20245# Joint Publications Research Service, Arlington, Va. **AUTOMATED SPECTRAL ANALYSIS OF DIMENSIONS AND DIRECTIONS OF STRUCTURAL ELEMENTS ON EARTH'S SURFACE Abstract Only**

D. K. TKHABISIMOV, D. A. UISKOV, and M. I. KOLSENIK *In its* USSR Report: Space (JPRS-USP-86-001) p 143 13 Jan. 1986 Transl. into ENGLISH from Issledovaniye Zemli iz Kosmosa (Moscow, USSR), no. 2, Mar. - Apr. 1985 p 3-80

Avail: NTIS HC A03

A method for a structural-zonal survey of the Earth's surface from space is proposed. In this method the surface is viewed through a moving window containing N X N resolution elements, which is called an operational unit. Some functionals, such as a matrix of integral relative energies in several zones of a Wiener spectrum (in a polar coordinate system), are computed for each operational unit. The Ziman method is used in determining the sizes of tree crowns and discriminating the predominant directions of lineaments on photographs of the Earth's surface. For each photograph fragment it is necessary to compute the functions C(m) and L(n) whose values correspond to the part of Wiener spectrum energy falling within annular and slit filters respectively. The analysis was made for models of a forest and lineament structures with a uniform distribution (with respect to positions and sizes), and also for real photographs. Maps of crown size were constructed by correlation analysis of Wiener spectra. The discriminated directions are determined by the local maxima of the L(n) function. A full algorithm is given for automated fragment-by-fragment spectral analysis of images. An analysis of models of images of structural elements is used in developing a method for retrieving the probability distribution function for tree crown sizes from the Fourier spectrum. Author

N86-20246# Joint Publications Research Service, Arlington, Va. **USE OF MATERIALS FROM LARGE-SCALE AERIAL PHOTOSURVEY OF FOREST IN AUTOMATED INTERPRETATION OF SPACE PHOTOGRAPHS Abstract Only**

L. A. KUZENKOV, N. A. APARINOVA, and A. V. STARCHENKO *In its* USSR Report: Space (JPRS-USP-86-001) p 143-144 13 Jan. 1986 Transl. into ENGLISH from Issledovaniye Zemli iz Kosmosa (Moscow, USSR), no. 2, Mar. - Apr. 1985 p 90-96
Original language document was announced in IAA as A85-37119

Avail: NTIS HC A03

A step-wise numerical technique to process large scale aerial survey data for forestry applications is described. The method is based on the SNIMOK-DANNYE computer system for processing photographic data obtained by satellite. A block diagram illustrating

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the step-wise processing procedure is given and the statistical correlation used to match forest features with suitable deciphering indicators is described. The technique has been used to process photographic data from 30 different aerial surveys of forest land in Iakutsk, USSR, and was found to be practical for widespread use. I.H. (IAA)

N86-20254# Joint Publications Research Service, Arlington, Va.
COMPREHENSIVE DESERTIFICATION MAPS AND METHODOLOGY FOR THEIR COMPILATION USING SPACE PHOTOGRAPHS Abstract Only

N. G. KHARIN *In its* USSR Report: Space (JPRS-USP-86-001) p 150 13 Jan. 1986 Transl. into ENGLISH from Issledovaniye Zemli iz Kosmosa (Moscow, USSR), no. 1, Jan. - Feb. 1985 p 52-59 Original language document was announced in IAA as A85-29907

Avail: NTIS HC A03

Quantitative criteria of desertification are proposed, and a method for the compilation of desertification maps on the basis of space remote sensing data is developed. The desertification aspects include the current status, the rate and inherent risk of desertification, and the effect of animals and humans on the environment. LANDSAT and Soyuz-22 data on southeast Turmenistan considered. B.J.(IAA)

N86-20255# Joint Publications Research Service, Arlington, Va.
USE OF SPACE METHODS FOR STUDYING SALINE SOILS AND SOLONCHAKS Abstract Only

E. A. MAMEDOV *In its* USSR Report: Space (JPRS-USP-86-001) p 151 13 Jan. 1986 Transl. into ENGLISH from Issledovaniye Zemli iz Kosmosa (Moscow, USSR), no. 1, Jan. - Feb. 1985 p 60-65 Original language document was announced in IAA as A85-29908

Avail: NTIS HC A03

There is a spatial-temporal variability of saline lands which requires a constant inventory of their area and state and a systematic revision and correction of soil maps. A high percentage of the lands in the Azerbaijan SSR falls in this category. Work in the Adzhinourskaya steppe is described. Key sectors have been covered by detailed geobotanical surveys on the ground, taking into account the seasonal variability of the vegetation cover. After preparation of a detailed map of the key area on the basis of aerial photographs and ground field work, it was possible to proceed to interpretation and mapping on the basis of space photographs. The 1972 space photographs used were from the LANDSAT satellite in four spectral zones. It was found that the most effective spectral zones for the mapping of saline soils are 0.6 to 0.7 and 0.8 to 1.1 micrometers. The use of maps prepared from space photographs greatly increased the detail of the maps in comparison with those prepared by traditional methods, clearly revealing the natural pattern of soil and vegetation groupings, increasing the number of varieties of saline and swampy soils and solonchaks by a factor 2 to 3. The outlines of individual soil areas discriminated on the basis of phototone and color fully corresponded to the results of field mapping and data from physiochemical analysis. It was concluded that in Azerbaijan such work is best accomplished using multizonal photographs taken in July-August at wavelengths 0.5 to 0.6 and 0.6 to 0.7 micrometers. R.J.F.

N86-20257# Joint Publications Research Service, Arlington, Va.
RADAR MAPPING OF MOISTURE CONTENT OF OPEN SOILS Abstract Only

N. N. KRUPENIO *In its* USSR Report: Space (JPRS-USP-86-001) p 152-153 13 Jan. 1986 Transl. into ENGLISH from Issledovaniya Zemli iz Kosmosa (Moscow, USSR), no. 1, Jan. - Feb. 1985 p 88-93 Original language document was announced in IAA as A85-29911

Avail: NTIS HC A03

Airborne sidelooking radar with a 60-100 m resolution was used for the moisture mapping of open soils (i.e., without vegetation cover) in the 0-10 cm layer in the Stavropol'sk region of the USSR. The difference between the moisture value obtained by the remote radar measurements and that obtained by direct

thermoweight measurements did not exceed 2 wt percent in the 9-30 percent moisture variation range. B.J. (IAA)

N86-20270# Joint Publications Research Service, Arlington, Va.
MAPPING OF VEGETATION RESOURCES OF ARID ZONES USING SPACE PHOTOINFORMATION Abstract Only

V. S. KHRUTSKIY *In its* USSR Report: Space (JPRS-USP-86-001) p 163 13 Jan. 1986 Transl. into ENGLISH from Geodeziya i Kartografiya (Moscow, USSR), no. 9, Sep. 1984 p 51-56 Original language document was announced in IAA as A85-14322

Avail: NTIS HC A03

The use of satellite remote-sensing techniques for the vegetation mapping of arid areas is examined, and the possibilities of the direct and indirect interpretation of vegetation cover using local landscape indicators are evaluated. Particular consideration is given to relief interpretation, the interpretation of rocks and friable deposits, and the interpretation and classification of vegetation. Finally, the characteristics of field and laboratory work pertaining to the generation of pasture maps are examined. L.M. (IAA)

N86-20450# Joint Publications Research Service, Arlington, Va.
STUDY OF SPATIAL STRUCTURE OF SOIL COVER IN BAYKAL REGION USING AEROSPACE PHOTOGRAPHS Abstract Only

V. A. KUZMIN *In its* USSR Report: Space (JPRS-USP-86-002) p 67 10 Feb. 1986 Transl. into ENGLISH from Issledovaniye Zemli iz Kosmosa (Moscow, USSR), no. 4, Jul. - Aug. 1985 p 53-57 Original language document was announced in IAA as A86-13282

Avail: NTIS HC A05

Soil cover and its changes can be studied best by using aerospace materials. It is best that soil regions be defined on photographs at 1:2,500,000. An example of a soils geography regionalization map, compiled from photographs at this scale, is illustrated. Regions are defined within the limits of plateaus, plains, high, intermediate and low mountains and basins. Photographs at 1:1,000,000 yield considerably more information; in addition to provinces and regions it is possible to define landscape units. Among the different photographic scales used the most detailed were intermediate scale photographs on which it is possible to discriminate districts soil micro- and mesostructures and elementary soil areas. In contrast to space photographs on aerial photographs it is possible to discriminate vegetation, micro- and mesorelief, and in cultivated areas such soil characteristics as humus content, moisture content, calcareousness, etc. In the study of soils geography the soil cover is reflected through the structure of different levels of organization. Author

N86-20451# Joint Publications Research Service, Arlington, Va.
RADIATION CORRECTION FOR AEROSPACE IMAGES OF AGRICULTURAL CROPS Abstract Only

A. S. BARYKIN, V. V. KOZODEROV, and V. P. POPOV *In its* USSR Report: Space (JPRS-USP-86-002) p 68-69 10 Feb. 1986 Transl. into ENGLISH from Issledovaniye Zemli iz Kosmosa (Moscow, USSR), no. 4, Jul. - Aug. 1985 p 78-85 Original language document was announced in IAA as A86-13285

Avail: NTIS HC A05

The methods used to calculate radiative corrections in thematic processing of remotely-sensed agricultural images are reviewed. The effect of atmospheric turbidity on the accuracy of thematic classifications is estimated by comparing corrected and uncorrected images. A radiative correction algorithm is derived based on model estimates of radiative transfer in the atmosphere and an orthogonal polynomial approximation of outgoing radiation. It is found that the accuracy of image classifications increased when the effect of atmospheric turbidity was removed. Some examples of the processed imagery are provided. I.H.

02 ENVIRONMENTAL CHANGES AND CULTURAL RESOURCES

N86-20932*# California Univ., Santa Barbara. Dept. of Geography.
CANOPY REFLECTANCE MODELING IN A TROPICAL WOODED GRASSLAND Semiannual Report
D. SIMONETT 31 Jan. 1986 5 p
(Contract NAGW-788)
(NASA-CR-176514; NAS 1.26:176514) Avail: NTIS HC A02/MF A01 CSCL 02F

A study area was selected in West Africa in order to establish a relationship between rainfall and grassland productivity, and also to provide ground measurements and support for the GIMMS investigation of the use of AVHRR vegetation index data for monitoring grassland biomass and productivity. Field data collection, image and collateral data acquisition, model development, and data analysis and processing are briefly discussed. E.R.

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ENVIRONMENTAL CHANGES AND CULTURAL RESOURCES

Includes land use analysis, urban and metropolitan studies, environmental impact, air and water pollution, geographic information systems, and geographic analysis.

A86-20651*
SPATIAL INFORMATION TECHNOLOGIES FOR REMOTE SENSING TODAY AND TOMORROW; PROCEEDINGS OF THE NINTH PECORA SYMPOSIUM, SIOUX FALLS, SD, OCTOBER 2-4, 1984

Symposium sponsored by IEEE, USGS, NASA, and ASP. Silver Spring, MD, Institute of Electrical and Electronics Engineers, Inc., 1984, 433 p. For individual items see A86-20652 to A86-20704.

Topics discussed at the symposium include hardware, geographic information system (GIS) implementation, processing remotely sensed data, spatial data structures, and NASA programs in remote sensing information systems. Attention is also given GIS applications, advanced techniques, artificial intelligence, graphics, spatial navigation, and classification. Papers are included on the design of computer software for geographic image processing, concepts for a global resource information system, algorithm development for spatial operators, and an application of expert systems technology to remotely sensed image analysis.

V.L.

A86-20654
GEOGRAPHIC INFORMATION SYSTEMS - AN OVERVIEW
D. F. MARBLE (New York, State University, Buffalo) IN: Spatial information technologies for remote sensing today and tomorrow; Proceedings of the Ninth Pecora Symposium, Sioux Falls, SD, October 2-4, 1984. Silver Spring, MD, Institute of Electrical and Electronics Engineers, Inc., 1984, p. 18-24. refs

This paper provides a general overview of the development of computer-based systems for spatial data handling. It examines the nature of these geographic information systems (GIS) and explores certain links in their development to developments in associated fields such as computer graphics, software engineering, and photogrammetry and remote sensing. The paper concludes with a brief enumeration of certain critical research areas and institutional developments which are felt to be necessary to insure continued, effective development of the field. Author

A86-20656* Michigan State Univ., East Lansing.
MICROCOMPUTER-BASED, STATEWIDE, DIGITAL LAND-SURFACE INFORMATION

D. P. LUSCH and W. R. ENSLIN (Michigan State University, East Lansing) IN: Spatial information technologies for remote sensing today and tomorrow; Proceedings of the Ninth Pecora Symposium, Sioux Falls, SD, October 2-4, 1984. Silver Spring, MD, Institute of Electrical and Electronics Engineers, Inc., 1984, p. 40-43. refs

(Contract NGL-23-004-083)

The Center for Remote Sensing at Michigan State University is developing a statewide data base of land-surface information on an ERDAS 400 microcomputer system. The raster file structure uses 1 square-kilometer grid cells and contains 633 columns and 733 rows. The initial elements of this data base include (1) augmented Level I land cover; (2) average available soil water capacity; (3) topographic information; and (4) multiple-vector, windward distance to the Great Lakes. Other elements will be added to the data base in the future in order to serve the multidisciplinary needs of the research community at Michigan State University. Author

A86-20668* Jet Propulsion Lab., California Inst. of Tech., Pasadena.
CONCEPTS FOR A GLOBAL RESOURCES INFORMATION SYSTEM

F. C. BILLINGSLEY and J. L. URENA (California Institute of Technology, Jet Propulsion Laboratory, Pasadena) IN: Spatial information technologies for remote sensing today and tomorrow; Proceedings of the Ninth Pecora Symposium, Sioux Falls, SD, October 2-4, 1984. Silver Spring, MD, Institute of Electrical and Electronics Engineers, Inc., 1984, p. 123-131. NASA-supported research. refs

The objective of the Global Resources Information System (GRIS) is to establish an effective and efficient information management system to meet the data access requirements of NASA and NASA-related scientists conducting large-scale, multi-disciplinary, multi-mission scientific investigations. Using standard interfaces and operating guidelines, diverse data systems can be integrated to provide the capabilities to access and process multiple geographically dispersed data sets and to develop the necessary procedures and algorithms to derive global resource information. Author

A86-20686#
TERRAIN ELEVATION AND SURFACE FEATURE DATA DISPLAY FOR MISSION, LAND USE, AND TRAFFICABILITY PLANNING

M. B. FAINTICH, J. SIMLEY, and R. FORTSON (DMA, Washington, DC) IN: Spatial information technologies for remote sensing today and tomorrow; Proceedings of the Ninth Pecora Symposium, Sioux Falls, SD, October 2-4, 1984. Silver Spring, MD, Institute of Electrical and Electronics Engineers, Inc., 1984, p. 278-285.

The Defense Mapping Agency produces digital data bases that describe the physical appearance of the surface of the earth. Using state-of-the-art display and analysis concepts in conjunction with sophisticated interactive computer graphic systems, a variety of geographic displays are available. These include color vector profiles, contours, and boundary plots, color raster map and analysis displays, and simulated visual and electro-optical sensor displays. Applications include mission planning for both ground and airborne operations, trafficability based upon terrain and surface cover, and general land use and resource management. Author

02 ENVIRONMENTAL CHANGES AND CULTURAL RESOURCES

A86-21101*

INTERNATIONAL SYMPOSIUM ON REMOTE SENSING OF ENVIRONMENT, 18TH, PARIS, FRANCE, OCTOBER 1-5, 1984, PROCEEDINGS. VOLUMES 1, 2, & 3

Symposium sponsored by CNES, Environmental Research Institute of Michigan, NASA, et al. Ann Arbor, MI, Environmental Research Institute of Michigan, 1985. Vol. 1, 699 p.; vol. 2, 701 p.; vol. 3, 713 p. In English and French. For individual items see A86-21102 to A86-21172, A86-21174 to A86-21273.

Papers are presented on the applications of satellite technology, such as monitoring of agriculture, appraising of natural resources, and studying disasters. Topics discussed include, advances in remote sensing processes, multisensor imaging, and mapping. Extensive consideration is given to the processing, modeling, integrating, and evaluating of satellite data. I.F.

A86-21124*# Army Cold Regions Research and Engineering Lab., Hanover, N. H.

OHIO RIVER MAIN STEM STUDY - THE ROLE OF GEOGRAPHIC INFORMATION SYSTEMS AND REMOTE SENSING IN FLOOD DAMAGE ASSESSMENTS

H. A. EDWARDS, F. R. MOULIS (U.S. Army, Engineer District, Pittsburgh, PA), C. J. MERRY, H. L. MCKIM (U.S. Army, Cold Regions Research and Engineering Laboratory, Hanover, NH), A. G. KERBER (NASA, Goddard Space Flight Center, Greenbelt, MD), and M. A. MILLER (NASA, Goddard Institute for Space Studies, Sigma Data Services Corp., New York) IN: International Symposium on Remote Sensing of Environment, 18th, Paris, France, October 1-5, 1984, Proceedings. Volume 1. Ann Arbor, MI, Environmental Research Institute of Michigan, 1985, p. 265-281. Army-sponsored research.

The Pittsburgh District, Corps of Engineers, has conducted feasibility analyses of various procedures for performing flood damage assessments along the main stem of the Ohio River. Procedures using traditional, although highly automated, techniques and those based on geographic information systems have been evaluated at a test site, the City of New Martinsville, Wetzel County, WV. The flood damage assessments of the test site developed from an automated, conventional structure-by-structure appraisal served as the ground truth data set. A geographic information system was developed for the test site which includes data on hydraulic reach, ground and reference flood elevations, and land use/cover. Damage assessments were made using land use mapping developed from an exhaustive field inspection of each tax parcel. This ground truth condition was considered to provide the best comparison of flood damages to the conventional approach. Also, four land use/cover data sets were developed from Thematic Mapper Simulator (TMS) and Landsat-4 Thematic Mapper (TM) data. One of these was also used to develop a damage assessment of the test site. This paper presents the comparative absolute and relative accuracies of land use/cover mapping and flood damage assessments, and the recommended role of geographic information systems aided by remote sensing for conducting flood damage assessments and updates along the main stem of the Ohio River. Author

A86-21125*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

REMOTE SENSING AND DISASTER MONITORING - A REVIEW OF APPLICATIONS IN INDONESIA

J. P. MALINGREAU (NASA, Goddard Space Flight Center, Greenbelt, MD) IN: International Symposium on Remote Sensing of Environment, 18th, Paris, France, October 1-5, 1984. Proceedings. Volume 1. Ann Arbor, MI, Environmental Research Institute of Michigan, 1985, p. 283-297. refs

The role played by remote sensors on-board the Landsat and NOAA-7 satellites in monitoring and management of three catastrophic events that took place in 1982 and 1983 in Indonesia (two major volcanic eruptions and a large-scale forest fire) is assessed. The modes of operation of the satellite platforms, the types of data derived, and data availability to the users are described, and the sources of failures and delays (such as the presence of clouds, technical and computer errors, red-tape, etc.)

are examined. The major drawbacks of the Landsat-supplied information for monitoring short-lived and fast-changing events were the insufficient frequency of data acquisition, delayed delivery of data, and extended times needed for data distribution and processing. Indonesia's NOAA-7 and GMS sensors, although of low spatial resolution, offered higher frequency of data collection, and profited from the existence of a local receiving station. The present value of the space-based imagery is seen mainly in the baseline assessment of the disaster-prone areas, which can assist in preparing these areas for the impending catastrophic events. I.S.

A86-21131#

GEMS AND GRID - CLOSING THE DATA LOOP

H. CROZE, C. BOELCKE, and M. D. GWYNNE (United Nations, Nairobi, Kenya) IN: International Symposium on Remote Sensing of Environment, 18th, Paris, France, October 1-5, 1984, Proceedings. Volume 1. Ann Arbor, MI, Environmental Research Institute of Michigan, 1985, p. 355-365. refs

GEMS, the Global Environment Monitoring System, which operates both within and outside the United Nations family of organizations, has been coordinating environmental monitoring and assessment activities for nearly a decade at thousands of sites throughout the world. GEMS deals with air, water, soil and food pollution, climate and renewable natural resources, including soil degradation, tropical forests, rangelands and endangered plant and animal species. In order to make GEMS-type environmental data of maximum use to both national and regional decision making, as well as for programming international development efforts, GEMS is establishing within the UN system a global resource information database (GRID). Author

A86-21155#

STUDY OF LANDSCAPE UNITS, ECOZONES AND BIOPHYSICAL LAND USE IN FRANCE'S DROME DEPARTMENT USING LANDSAT DATA

A. BOEMARE (Drome, Conseil d'Architecture, d'Urbanisme et de l'Environnement, Valence, France) and M. LENCO (Ministere de l'Environnement, Paris, France) IN: International Symposium on Remote Sensing of Environment, 18th, Paris, France, October 1-5, 1984, Proceedings. Volume 1. Ann Arbor, MI, Environmental Research Institute of Michigan, 1985, p. 595-602. In French.

The target of the study was to sensitize the local authorities of the Drome department in S.E. of France to environmental problems by means of remote sensing informations and also to show the possibilities afforded by remote sensing to analyze the environmental phenomena. The study consisted in visual interpretation of a restored enhanced false color image at 1:100,000 scale which was obtained by processing of Landsat MSS data. The interpretation was digitized and provided cartographic and numerical (ha) results in administrative, geographical and watershed boundaries about ecozones, biophysical land use divided in 40 classes, and landscape units according three levels. The results were compared with other external cartographic data to undertake thematic or synthetic studies and to bring an assistance to decisions by ecozone and landscape or administrative unit for environmental problems such as conservation of wetlands, of ecological zones of interest for flora and fauna, of forests and agricultural activity, water policy, and quarries policy. Author

A86-21161#

RECENT CONTRIBUTIONS OF SATELLITE REMOTE SENSING TO THE IMPLEMENTATION OF REGIONAL ENVIRONMENTAL POLICY IN ILE DE FRANCE (PARIS REGION) THROUGH THE QUANTITATIVE MAPPING OF URBAN VEGETATION

R. DELAVIGNE and C. THIBAUT (Ile-de-France, Institut d'Amenagement et d'Urbanisme, Paris, France) IN: International Symposium on Remote Sensing of Environment, 18th, Paris, France, October 1-5, 1984, Proceedings. Volume 2. Ann Arbor, MI, Environmental Research Institute of Michigan, 1985, p. 675-691.

A86-21162#

POTENTIAL APPLICATIONS FOR SPOT DATA IN THE PARIS REGION FROM THE RESULTS OF 1981 AND 1983 SIMULATION STUDIES

A. BALLUT (Ile-de-France, Institut d'Amenagement et d'Urbanisme, Paris, France) and P. T. NGUYEN (IBM France, S. A., Paris, France) IN: International Symposium on Remote Sensing of Environment, 18th, Paris, France, October 1-5, 1984, Proceedings. Volume 2. Ann Arbor, MI, Environmental Research Institute of Michigan, 1985, p. 693-703.

Two methods of change detection using two sets of SPOT simulation data acquired on the Paris area are investigated. The first method uses the maximum likelihood to detect the land use units at two dates and the classified images are used to determine the changes. In the second the reflectance at the two dates are compared and area with radiometric changes are detected. These methods can detect area of changes of 5000 sq km and 1250 sq m respectively. The detected changes are analyzed using aerial photographs to determine the exact nature of the changes.

Author

A86-21181#

REMOTE SENSING OF URBAN CHARACTERISTICS USING A SPOT SIMULATION

L. CHARBONNEAU, R. BROCHU, D. MORIN, and F. BONN (Sherbrooke, Universite, Canada) IN: International Symposium on Remote Sensing of Environment, 18th, Paris, France, October 1-5, 1984, Proceedings. Volume 2. Ann Arbor, MI, Environmental Research Institute of Michigan, 1985, p. 961-969. refs (Contract NSERC-A-5252)

The object of this study is to evaluate the potential of SPOT in multispectral mode for mapping urban land use. On June 10, 1982 a SPOT simulation was conducted over the city of Sherbrooke by the Canada Centre for Remote Sensing using a Daedalus scanner (DS 1260). Of all the land units the most characteristic were chosen. The themes were generated from a supervised classification based on the spectral properties of urban environments. Ten land cover classes have been identified by the supervised classification process, and have been compared with an existing land use map.

Author

A86-21190#

PRODUCTION OF A NATIONAL ROAD-ATLAS IN SWEDEN BASED ON LANDSAT DATA

A. GREEN ENGBERG, S. OLOVSSON, H. OLSSON (Swedish Space Corp., Solna, Sweden), and L. SKOG (ESSELTE Map Service, Stockholm, Sweden) IN: International Symposium on Remote Sensing of Environment, 18th, Paris, France, October 1-5, 1984, Proceedings. Volume 2. Ann Arbor, MI, Environmental Research Institute of Michigan, 1985, p. 1075-1079.

In a joint project, the Swedish Space Corporation has provided ESSELTE Map Service with geometrically corrected and classified digital Landsat MSS information. The satellite information has been combined with digital cartographic data, and final films for printing color maps have been output on a laser plotter. A national coverage at the scale of 1:200,000 of printed maps with satellite and digital cartographic data will introduce a new concept to Swedish map consumers.

Author

A86-21191#

THE USE OF SATELLITE IMAGES IN THE STUDY OF URBAN ENVIRONMENT AND AS A GUIDELINE IN CITY PLANNING

M. LOMBARDO and J. R. TARIFA (Sao Paulo, Universidade, Brazil) IN: International Symposium on Remote Sensing of Environment, 18th, Paris, France, October 1-5, 1984, Proceedings. Volume 2. Ann Arbor, MI, Environmental Research Institute of Michigan, 1985, p. 1091-1099. refs

In this study, an attempt was made to verify the alteration of the urban environment by the utilization of satellite images and data of pollution. The integration of the interpretation of the Landsat data mapping the use of urban soil and of thermal images from the meteorological satellite in the analysis of temperature variations associated with the pollution data helped in the identification of

areas with the most problems of environment degradation.

Author

A86-21198#

THE USES OF SATELLITE IMAGERY FOR THE PLANNING AND MANAGEMENT OF RURAL DEVELOPMENT PROJECTS

N. P. FREELAND (Masdar Technology, Ltd., Wokingham, England) IN: International Symposium on Remote Sensing of Environment, 18th, Paris, France, October 1-5, 1984, Proceedings. Volume 2. Ann Arbor, MI, Environmental Research Institute of Michigan, 1985, p. 1167-1176.

A86-21211#

TRIAL APPLICATION OF SPACE REMOTE SENSING AS AN AID TO IMPACT ASSESSMENT OF MAJOR LINEAR INFRASTRUCTURE WORKS

M. LENCO (Ministere de l'Environnement, Paris, France) IN: International Symposium on Remote Sensing of Environment, 18th, Paris, France, October 1-5, 1984, Proceedings. Volume 3. Ann Arbor, MI, Environmental Research Institute of Michigan, 1985, p. 1353-1370. refs

One of the applications considered is related to the identification of zones of minimum impact for the proposed Lannemezan Zaragoza EHT (extremely high voltage) power line between southwest France and Spain. Another application involves an assessment of the impact of the proposed 'Atlantic' route for the French TGV (high speed train) project. Each of the two investigations conducted involved the use of restored enhanced false color images which covered the entire length of the considered linear structure. The employed images had been obtained on the basis of Landsat 2 data. The analysis discussed had the objective to obtain up-to-date information regarding the effect of the proposed routes on the environment, giving particular attention to critical areas.

G.R.

A86-21226#

SHAPE-ASSISTED LAND-USE CLASSIFICATION FOR REMOTELY SENSED DATA

K. C. CLARKE (Hunter College, New York) IN: International Symposium on Remote Sensing of Environment, 18th, Paris, France, October 1-5, 1984, Proceedings. Volume 3. Ann Arbor, MI, Environmental Research Institute of Michigan, 1985, p. 1517-1525. Research supported by the City University of New York. refs

This study investigates the feasibility of incorporating quantitative information about land-use area shape into the land-use classification process. Previous approaches to land-use classification from remotely sensed data have relied almost entirely upon spectral properties of the land surface cover alone. Part of the United States Geological Survey 1:250,000 land-use series map for Cape Cod, Massachusetts was digitized and used to calculate fourteen vector-based shape measures. Of these, nine were used to analyze the shapes of the land-use areas, both individually and collectively using principal components analysis. Some links between spatial shape and land-use were noted, but the size of the data set and the range of the land-uses chosen was not sufficient to draw further conclusions. Extensions of the use of shape logic in the land-use classification process were considered, including the use of raster-based shape measures. The author proposes that a shape-based set of classification procedures be developed, to assist the spectral techniques currently in use.

Author

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A86-21236#

CONTRIBUTION OF SATELLITE IMAGERY FOR THE STUDY OF FRANCE'S REGIONAL NATURAL PARKS

J.-P. DEDIEU (Societe Francaise d'Etudes et de Recherches Economiques et Statistiques, Chambéry, France) and M. LENCO (Secretariat d'Etat et a l'Environnement et a l'Environnement et a la Qualite de la Vie, Neuilly-sur-Seine, France) IN: International Symposium on Remote Sensing of Environment, 18th, Paris, France, October 1-5, 1984, Proceedings. Volume 3. Ann Arbor, MI, Environmental Research Institute of Michigan, 1985, p. 1629-1642. In French.

The usefulness of Landsat images as a source of information concerning France's regional natural parks is noted, and it is pointed out that the areal extent of these geographic areas makes them well-suited for Landsat studies at 1/100,000 scale. Landsat images of the parks provide a homogeneous data set that may be economically updated for the different ecozones and biophysical land use units present within the park boundaries. Examples of interpretation are given for the Parc du Vercors, the Parc du Jura Gessien (planned), and the Parc du Morvan. D.H.

A86-21238#

APPLICATION OF SATELLITE REMOTE SENSING AND GEOGRAPHIC INFORMATION SYSTEMS TO THE MANAGEMENT OF NATURAL RESOURCES

R. MANIERE (Nice, Universite, France), A. GIRAUD (Paris, Ecole Nationale Supérieure des Mines, Valbonne, France), and J. CLAUDIN (Service d'Interpretation du Milieu Naturel, Nice, France) IN: International Symposium on Remote Sensing of Environment, 18th, Paris, France, October 1-5, 1984, Proceedings. Volume 3. Ann Arbor, MI, Environmental Research Institute of Michigan, 1985, p. 1659-1669. CNRS-supported research. refs

A geographic information system on the environment has been set up and tested within the framework of a multi-disciplinary program financed jointly by the National Space Research Center (CNRS) and the Provence-Alpes-Cote d'Azur regional authority. The study area is the Mercantour National Park. The main aspects of the study are the creation of a geocoded database covering the main descriptors of the environment, including a digital terrain model, and the use of satellite data (Landsat, HOMM, SPOT Simulation). The goal is improved management of rural areas in medium and high mountain ranges. D.H.

A86-21241#

SATELLITE IMAGERY FOR ROAD PROJECT

G. CHAMPETIER DE RIBES (Laboratoire Central des Ponts et Chaussées, Paris, France) and M. DORIDOT (Laboratoire Regional de l'Est Parisien, Paris, France) IN: International Symposium on Remote Sensing of Environment, 18th, Paris, France, October 1-5, 1984, Proceedings. Volume 3. Ann Arbor, MI, Environmental Research Institute of Michigan, 1985, p. 1689-1691.

Data from Landsat 1, 2 and 3 have been used to advantage in connection with road alignment studies in Niger and Zaire. Careful analysis of the drainage pattern, the indirect consequences of this analysis on the morphological and geological characteristics of the region, and potential sources of construction materials are a few of the themes to which these new remote sensing techniques can most profitably be applied. All results acquired in the course of these researches are combined in a methodological framework of which the broad outlines are described. Author

A86-21266#

INFLUENCE OF SNOW COVER RECESSION ON AN ALPINE ECOLOGICAL SYSTEM

M. KELLER and K. SEIDEL (Zuerich, Eidgenoessische Technische Hochschule, Switzerland) IN: International Symposium on Remote Sensing of Environment, 18th, Paris, France, October 1-5, 1984, Proceedings. Volume 3. Ann Arbor, MI, Environmental Research Institute of Michigan, 1985, p. 1931-1936. SNSF-supported research. refs

A study of high Alpine regions is being conducted as part of the worldwide UNESCO program 'Man and Biosphere (MAB)' which is examining the mutual effects of economic activities, land use,

and natural resources. At test site MAB-Davos, virtually all available data on climate, forestry, game biology, landscape history, soil science, vegetation, and human activities have been assembled into a Geographical Information System (GIS). For a period in 1981, a set of snow cover distribution maps has been derived using Landsat-MSS imagery. The quantitative comparison of the snow cover recession with certain GIS-layers stimulates a better understanding of natural processes and interactions. D.H.

A86-22557

ASPECTS OF RAILROAD PLANNING IN COMPLEX ENVIRONMENTAL CONDITIONS USING SPACE IMAGERY [NEKOTORYE ASPEKTY PROEKTIROVANIYA ZHELEZNYKH DOROG V SLOZHNYKH PRIRODNYKH USLOVIYAKH S ISPOL'ZOVANIEM MATERIALOV S'EMOK]

A. I. BOGDANOV (Moskovskii Institut Inzhenerov Zheleznodorozhnogo Transporta, Moscow, USSR) Issledovanie Zemli iz Kosmosa (ISSN 0205-9614), Sept.-Oct. 1985, p. 58-60. In Russian.

A86-22649

ESTIMATING URBAN VEGETATION COVER IN LOS ANGELES

D. E. BROWN and A. M. WINER (California, University, Riverside) Photogrammetric Engineering and Remote Sensing (ISSN 0099-1112), vol. 52, Jan. 1986, p. 117-123. Research supported by the California Air Resources Board. refs

Urban vegetation in the Los Angeles basin was analyzed as part of an investigation to estimate hydrocarbon emissions from leaf mass, and to assess the potential contribution of such emissions to photochemical air pollution. A positive print mosaic of NASA U-2 color infrared photographs (taken in 1972) was used for regional delineation of broad vegetation land-use categories. Urban areas were additionally subdivided into sampling polygons. Randomly selected cells within 20 defined polygons were photographed in 1982 by a low altitude flight (1:3,000) with color infrared film. Vegetation was mapped and digitized for cover by a physiognomic classification which included trees, palm trees, shrubs, ground cover, and grasses. Urban vegetation cover ranged from about 4 percent to 58 percent for the sites sampled, with an average value of 27 percent. Field teams obtained vegetation cover and biomass data for the sample sites. Integration of the photography and field data provided leaf mass estimates for each vegetation class. Author

A86-22723

MONITORING AND SURVEILLANCE OF THE EUROPEAN ENVIRONMENT WITH THE NOAA-AVHRR (DIGITAL) SATELLITE [ERFORSCHUNG - OBERWACHUNG DER EUROPAELSCHEN UMWELT MIT NOAA-AVHRR (DIGITAL) SATELLITENDATEN]

H. KAMINSKI (Bochum, Sternwarte, West Germany) IN: European Telemetry Conference, 7th, Boeblingen, West Germany, May 21-24, 1984, Reports. Part 2. Wessling, West Germany, Arbeitskreis Telemetrie, 1984, p. 8.1-8.1.18. In German. refs

During the last few decades, Europe has to cope with environmental problems of increasing severity. These problems can be divided into three main categories. One is related to bad environmental conditions in the case of rivers, coasts, and interior large bodies of water, such as the Baltic Sea. Another category of problems is concerned with the pollution of the atmosphere, while the third category includes problems affecting the land surface of Europe. For an objective description of the environmental situation, it is necessary to determine the existing conditions on the basis of a large-area diagnosis. Earth satellites, unmanned or manned, appear particularly suited for obtaining the required data. The satellites which are best suited include the NOAA satellites, the Landsat satellites, the Nimbus satellites, and the Space Shuttle with Spacelab. G.R.

A86-22834

PRELIMINARY EVALUATION OF SIMULATED SPOT DATA FOR CULTURAL RESOURCE ASSESSMENT - AN EXPERIMENT AT BANDELIER NATIONAL MONUMENT, NEW MEXICO

M. INGLIS, T. K. BUDGE (New Mexico, University, Albuquerque), and J. I. EBERT IN: SPOT simulation applications handbook; Proceedings of the SPOT Symposium, Scottsdale, AZ, May 20-23, 1984. Falls Church, VA, American Society of Photogrammetry, 1984, p. 73-82. refs

Multispectral scanner data, especially when used in concert with aerial photographs and other remote sensor data sources, have been illustrated to have promise as input to sampling designs, assessments, and predictive models directed toward cultural resources. While experiments in the actual discovery of archaeological sites and other cultural resources using Landsat data have recently been reported, the use of simulated three channel 20m SPOT data in this paper will focus less on the potential for actually detecting site signatures as upon the modeling of (1) characteristics of the natural environment that might be useful in predicting the location and nature of past human activities and thus the remains resulting from these activities; and (2) the recognition and measurement of natural, primarily surface, or immediately subsurface geomorphological processes responsible for the deposition of archaeological materials and their post-depositional preservation or alteration. Author

A86-22841

COMPARATIVE EVALUATION OF SIMULATION SPOT, LANDSAT-TM AND NHAP CIR DATA FOR URBAN LAND COVER AND IMPERVIOUS SURFACE IDENTIFICATION

M. G. DOLAN, S. R. MARTIN (Regional Planning Council, Baltimore, MD), and L. J. WARNICK (Earth Satellite Corp., Chevy Chase, MD) IN: SPOT simulation applications handbook; Proceedings of the SPOT Symposium, Scottsdale, AZ, May 20-23, 1984. Falls Church, VA, American Society of Photogrammetry, 1984, p. 148-156.

The Regional Planning Council (RPC) is an areawide planning agency, covering the City of Baltimore, Maryland, and its metropolitan area. The RPC provides information and conducts analyses for both local and state governments in the areas of land use/land cover, water quality, air quality, transportation, housing, economics, and other areas. Remote sensing tools and methods can assist the RPC in the performance of its function. However, the potential applicability of Landsat-TM and future SPOT-type data, with spatial resolutions ranging from 10 m to 30 m, is not clearly established. In an attempt to obtain some information regarding such an applicability, RPC is conducting a series of analyses of NHAP CIR, Landsat-TM, and simulated SPOT data. Some preliminary conclusions are discussed. It is found that NAHP CIR at 1:58,000 is superior to either SPOT-type or TM resolution data for first-time mapping of land use/land cover at the level of detail desired by the local governments. G.R.

A86-22843*

National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

INVESTIGATION OF SPOT SPECTRAL CHARACTERISTICS FOR DISCRIMINATING LAND USE AND LAND COVER IN PRINCE GEORGE'S COUNTY, MARYLAND

D. L. TOLL (NASA, Goddard Space Flight Center, Greenbelt, MD) and R. E. KENNARD (Science Applications Research, Riverdale, MD) IN: SPOT simulation applications handbook; Proceedings of the SPOT Symposium, Scottsdale, AZ, May 20-23, 1984. Falls Church, VA, American Society of Photogrammetry, 1984, p. 165-170.

A86-22845

APPLICATIONS OF SIMULATED SPOT DATA TO MAPPING LAND COVER PATTERNS AND CHANGES IN AN URBAN FRINGE ENVIRONMENT

V. A. MILAZZO and R. H. DEANGELIS (USGS, National Mapping Div., Reston, VA) IN: SPOT simulation applications handbook; Proceedings of the SPOT Symposium, Scottsdale, AZ, May 20-23, 1984. Falls Church, VA, American Society of Photogrammetry, 1984, p. 177-186. refs

Applications to geographic and cartographic research of simulated multispectral data, as anticipated from the SPOT satellite, are being investigated. One area of this research focuses on assessing the system's potential, particularly in terms of its increased spatial resolution, for use in the compilation, inspection, and (or) revision of certain thematic and planimetric map data currently derived from high-resolution aerial photographs. In this study, simulated SPOT data, in both image and digital formats, are being analyzed with respect to the classification and mapping of land use and land cover and the detection of change within an urban fringe environment. Preliminary findings indicate that the higher spatial resolution of the multispectral digital image product yields a level and accuracy of data appropriate for certain small-scale (1:250,000) and, in some cases, intermediate (1:100,000) to large-scale (1:24,000) mapping applications. Investigations involving computer-aided classification of the digital data are ongoing, but preliminary analyses indicate that the higher spatial resolution of SPOT data holds fewer advantages when using machine processing rather than visual interpretation techniques. Author

A86-24617

A SMALL SCALE REGIONAL ANALYSIS FROM PHOTOGRAPHS TAKEN WITH THE SPACELAB METRIC CAMERA - BOTANICAL AND PEDOLOGICAL APPROACH (INTERPRETATION DU PAYSAGE A PETITE ECHELLE A PARTIR DE CLICHES DE LA CHAMBRE METRIQUE SPACELAB - APPROCHE BOTANIQUE ET PEDOLOGIQUE)

C. M. GIRARD and M. C. GIRARD (Institut National Agronomique, Paris, France) Societe Francaise de Photogrammetrie et de Teledetection, Bulletin (ISSN 0244-6014), no. 99, 1985, p. 41-51. In French. refs

The Spacelab-1 metric camera was used to obtain stereoscopic views of the northwest region of France with a one square hectare resolution at a scale of 1:820,000. The data were treated in terms of the geomorphology, hydrologic networks, land use and the sizes of differentiated parcels. Interpretations were performed as functions of constant brightness, the similarities of structure and the organizations of the countryside, and the farmed land. Farm sectors were further broken down by geomorphology, the drainage patterns and the types of soil use. The data, revealing associations between crop vigor and the soil types and geomorphology, can lead to better land management. Specific examples are provided of interpretations of the metric camera data to identify the vegetal types which grow on different soil types on plateaus, slopes, plains and alluvial systems. M.S.K.

A86-24618

AN ANALYSIS OF THE INFORMATION CONTENT OF PHOTOGRAPHY CARRIED OUT ON SPACELAB-1 - APPLICATION TO LAND MANAGEMENT STUDIES (ANALYSE DU NIVEAU D'INFORMATIONS RECUEILLIES A PARTIR DES PHOTOGRAPHIES DE SPACELAB-1 - APPLICATION AUX ETUDES D'AMENAGEMENT)

J.-L. PELLETER (Laboratoire Regional de l'Est Parisien, Melun, France) Societe Francaise de Photogrammetrie et de Teledetection, Bulletin (ISSN 0244-6014), no. 99, 1985, p. 53-64. In French.

The information content of the panchromatic photographs obtained on the Spacelab-1 mission was assessed to determine their usefulness. The photographs were taken at a solar zenith angle of 15 deg at a scale of 1:810,000, yielding a swath 185 km across. Stereoscopic views were formed using two photographs taken 5 sec apart. Further refinement of the images enhanced

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the resolution to 1:100,000 and 1:50,000, i.e., scales employed for civil engineering. The images selected were of the region northeast of Avignon. Attention was given to the imagery contents such as lineaments, geological units, structural units, land use patterns and the organization of the countryside. The photographs, using high quality emulsions, were concluded to yield useful data on scales ranging from 1:500,000 to 1:50,000. It is noted that the images would be of particular use in regions targeted for development.

M.S.K.

A86-25594

ANTHROPOGENIC EFFECTS ON THE ENVIRONMENTS ACCORDING TO OBSERVATIONS FROM SPACE [ANTROPOGENNYYE VOZDEISTVIA NA PRIRODNUIU SREDU PO NABLIUDENIIAM IZ KOSMOSA]

A. A. GRIGOREV Leningrad, Izdatel'stvo Nauka, 1985, 240 p. In Russian. refs

Remote-sensing concerning many regional and planetary-scale disruptions of the environment are presented. Harmful effects of human activity in the hydrosphere, lithosphere, atmosphere, and biosphere are described. The use of data supplied by Landsat, Salyut, and other spacecraft in the evaluation of conditions and development of land use and of changes effected by the activity of large cities on the environment is discussed. Consideration is given to major environmental transformations that have occurred in Sahel, the Aral Sea area, and Vietnam. International aspects of satellite-based monitoring of the global ecosystems are also considered.

I.S.

A86-28590

ENVIRONMENT RELATED COOPERATION

J. BRETON (CNES, Toulouse, France) IN: Europe/United States space activities. San Diego, CA, Univelt, Inc., 1985, p. 251-262. (AAS 85-132)

The role of the French Centre National d'Etudes Spatiales (CNES) in developing environmental monitoring satellites for navigational applications is discussed. A review of the history of remote sensing and environmental monitoring projects at CNES is given, with reference made to the D1, EOLE, French Starlet, and ARGOS satellite programs. The data acquisition and localization operations of the current generation of ARGOS satellites (ARGOS-2), are described in detail. Attention is given to the reduction in throughput time which has been achieved in current ARGOS systems due to their enhanced ground segment data processing capability. The design of a 406-MHz satellite system for the SARSAT network, which is based on the ARGOS-2 satellite is also described, and the possibility of using geosynchronous satellite to detect distress emissions from ships at sea is briefly considered. A map showing the ground stations in the SARSAT network is provided.

I.H.

A86-29402

EDUCATION IN ENVIRONMENTAL REMOTE SENSING - A BIBLIOGRAPHY AND CHARACTERIZATION OF DOCTORAL DISSERTATIONS

R. W. MERIDETH, JR. and A. B. SACKS (Wisconsin, University, Madison) Photogrammetric Engineering and Remote Sensing (ISSN 0099-1112), vol. 52, March 1986, p. 349-365. refs

N86-17815*# Murray State Univ., Ky. Mid-America Remote Sensing Center.

DETERMINATION OF THE UTILITY OF REMOTE SENSING DATA FOR LAND USE/COVER ANALYSIS IN THE LOWER APPALACHIA REGION: ASSESSING THE UTILITY OF REMOTE SENSING DATA FOR ARCHEOLOGICAL SITE RECOGNITION Final Report

N. V. WEBER 15 Aug. 1983 48 p Original contains color imagery. Original photography may be purchased from the EROS Data Center, Sioux Falls, S.D. 57198 ERTS

(Contract NAS13-200)

(E86-10021; NASA-CR-176435; NAS 1.26:176435) Avail: NTIS HC A03/MF A01 CSCL 05B

Thematic Mapper Simulator (TMS) data were gathered by NASA/ERL over a portion of the lower Ohio River and the middle Mississippi River valleys on April 11, 1982. CIR imagery accompanied the 10 and 30 meter resolution TMS data sets. This area is somewhat unique archeologically as there exists a concentration of sites with major features such as mounds, earthworks, and villages. It was the primary purpose of this study to determine the utility of TMS data in identifying signatures which are distinctly archeological. TMS data were processed using the NASA/ERL software package ELAS. No signatures that were distinctly archeological were detected, due in large part to the complexity of the land cover and land use practices. However, as more sophisticated classification techniques were employed, the classes which were related to archeological features were narrowed. TMS data could certainly be of assistance to a trained archeologist/interpreter in narrowing an area which has to be field-surveyed as anomalous features can be recognized within a particular environmental context.

Author

N86-18368# Exmoor National Park Dept., Dulverton (England). REMOTE SENSING FOR ENVIRONMENTAL MANAGEMENT OF BRITISH NATIONAL PARKS: REVIEW AND PREVIEW

L. F. CURTIS In ESA Proceedings of EARSeL/ESA Symposium on European Remote Sensing Opportunities: Systems, Sensors, and Applications p 107-114 Jun. 1985 refs

Avail: NTIS HC A12/MF A01

Land cover maps and environmental quality assessment in National Parks in England and Wales are discussed. Remote sensing platforms used include autogyros, aircraft, and satellites. The role of color and infrared color photography increased. The development of image analysis of Multispectral Scanner (MSS) and Thematic Mapper (TM) data results in a major improvement in the operational capability of satellite data. The use of ratio (vegetation index) and image enhancement techniques for Exmoor National Park is described and work in other National Parks is reviewed. Proposals for further studies include comparative studies using MSS, TM and SPOT data.

Author (ESA)

N86-20980# European Space Agency, Paris (France).

DFVLR MEASURING SYSTEM FOR THE DETERMINATION OF THE SPATIAL DISTRIBUTION OF ENVIRONMENTAL PARAMETERS OF THE ATMOSPHERE BY MEANS OF MOBILE INSTRUMENTED PLATFORMS

D. PAFFRATH Aug. 1985 73 p refs Transl. into ENGLISH of "DFVLR-Messsystem zur Erfassung der räumlichen Verteilung von Umweltparametern in der Atmosphäre mit mobilen Messträgern" Rept. DFVLR-FB-85-09 Oberpfaffenhofen, West Germany, Dec. 1984 Original report in GERMAN previously announced as N85-28472

(ESA-TT-924; DFVLR-FB-85-09) Avail: NTIS HC A05/MF A01; original German version available from DFVLR, Cologne DM 21

Mobile measuring platforms and measurement methods for the quantitative determination of the spatial distribution of air pollution concentration and of meteorological parameters are described. The measuring instruments are installed in a twin-engined airplane for environmental research, in three vector gliders for acquisition of meteorological parameters, in a van for measuring aerosol and air pollution, and in a lidar system container for determination of the horizontal and vertical aerosol distribution.

Author (ESA)

N86-21967 Stanford Univ., Calif.

SPATIAL CLASSIFICATION OF URBAN LANDSCAPES FROM LANDCOVER PROBABILITIES DERIVED THROUGH REMOTE SENSING Ph.D. Thesis

E. C. DRISCOLL, JR. 1985 172 p

Avail: Univ. Microfilms Order No. DA8522134

A technique for classification of urban landuses from remotely sensed data such as aerial photographs is presented. Simulating the behavior of a human airphoto interpreter, it uses a two-stage approach, recognizing first landcover and then landuse. In the first stage, a straightforward multispectral classification technique is used to generate probability maps for a set of urban landcovers, e.g., grass, trees, asphalt, concrete, and shadow. Then the spatial nature of these landcover probabilities is examined and landuses are predicted based on neighborhood landcover mix and structure. Varying neighborhood sizes are explored. The algorithm is tested on a large urban dataset of Palo Alto, California, obtained by scanning a high altitude, infrared, aerial photograph to an effective resolution of 1.5 meters. Dissert. Abstr.

03

GEODESY AND CARTOGRAPHY

Includes mapping and topography.

A86-21107#

APPLICATION OF SPOT AND D.T.M. TO CARTOGRAPHY

A. BAUDOUIN (Institut Geographique National, Saint-Mande, France) IN: International Symposium on Remote Sensing of Environment, 18th, Paris, France, October 1-5, 1984, Proceedings. Volume 1. Ann Arbor, MI, Environmental Research Institute of Michigan, 1985, p. 61-74. refs

SPOT could be a very useful tool to cartographers with its high resolution sensors and its stereoscopic capabilities. SPOT images and Digital Terrain Models will be merged or derived from one to another in order to produce new geographical data. Stereo pairs and multi-incidence observations will be used to generate a ground control points network and digital terrain models where basic maps are missing. Optical and digital equipments have both their advantages to process SPOT images. When a D.T.M. already exists it could be used to rectify a vertical or oblique view, even in mountainous areas, with a high cartographic accuracy (10 m). It could be used also to generate stereo-ortho images in order to get a 3 D spacemap. Merging SPOT images with a D.T.M. or derived products (slopes, sun illumination) could be very useful to get a better classification of an image: especially in mountainous areas where spectral signatures of vegetation depends on the sun illumination conditions. The classification should be improved using multi-incidence observations. In order to be able to merge all these images and data, geocoded data bases will be developed. They will give the opportunity to the user to get a map, which is more accurate and up to date, and easier to use. Author

A86-26347

ADVANCES IN GEOPHYSICS. VOLUME 26

B. SALTZMAN, ED. (Yale University, New Haven, CT) Orlando, FL, Academic Press, Inc., 1984, 357 p. For individual items see A86-26348 to A86-26350.

Papers are presented on the structure of the inner and outer cores and the lower mantle, and on climate model simulations of CO₂-induced climatic changes. Topics discussed include prepleistocene paleoclimates, geological and paleontological evidence, and the modeling strategies and boundary conditions for paleoclimates. Consideration is given to the retrieval of precipitation and other geophysical parameters using satellite microwave systems. I.F.

A86-26425

ON UTILITY OF SPACE-BORNE VECTOR MAGNETIC MEASUREMENTS IN CRUSTAL STUDIES

A. K. AGARWAL, B. P. SINGH, R. G. RASTOGI, and S. SRINIVASAN (Indian Institute of Geomagnetism, Bombay, India) Physics of the Earth and Planetary Interiors (ISSN 0031-9201), vol. 41, Jan. 31, 1986, p. 260-268. refs

Satellite magnetic field data over India are examined in order to determine the usefulness of vector magnetic measurements in crustal studies. The procedures for isolating components of crustal origin from the magnetic field data in order to develop an anomaly map are described. The generated maps for B, X, Y, and Z fields are compared with the anomaly map of the Indian region by Langel et al. (1982b). The generated maps exhibit better resolution than the maps of Langel et al. and display features associated with the Indian Ocean geoid low. The internal consistency of the reduction technique is evaluated by comparing three vector B maps with a map derived from direct measurements; good correlation is observed demonstrating the applicability of the maps to crustal studies. I.F.

A86-29433#

THE SATELLITE DERIVED GEOID FOR SCANDINAVIA AND THE ARCTIC REGIONS - CRUSTAL STRUCTURE, LAND UPLIFT AND PLATE TECTONIC INFLUENCE

A. J. ANDERSON and F. PENG (Uppsala, Universitet, Sweden) IN: International Symposium on Space Techniques for Geodynamics, Sopron, Hungary, July 9-13, 1984, Proceedings. Volume 1. Sopron, Hungary, Magyar Tudomanyos Akademia Geodeziai es Geofizikai Kutato Intezet, 1984, p. 101-120. refs

A86-29439#

A COMPARISON OF CEI, VLBI, BIH AND USNO EARTH ORIENTATION INFORMATION

D. D. MCCARTHY, A. K. BABCOCK, and D. N. MATSAKIS (U.S. Naval Observatory, Washington, DC) IN: International Symposium on Space Techniques for Geodynamics, Sopron, Hungary, July 9-13, 1984, Proceedings. Volume 1. Sopron, Hungary, Magyar Tudomanyos Akademia Geodeziai es Geofizikai Kutato Intezet, 1984, p. 199-213.

Two radio astrometric techniques used to determine the earth's orientation in space are examined. Comparisons are made of the earth orientation information obtained by the connected-element interferometry (CEI) method and the very long baseline interferometry (VLBI) methods against the standard data sets of the U.S. Naval Observatory (USNO) and the Bureau International de l'Heure, and the two sets themselves are intercompared. The analysis shows that in the polar coordinates the USNO and BIH have nearly the same accuracy. The VLBI data, from the National Geodetic Survey's Project Polaris, show degraded accuracy in x, and there are too few independent determinations in y by Polaris to analyze them properly. Good agreement is seen between the USNO and Polaris residuals in UT1-UTC, indicating that the BIH is too heavily smoothed and fails to account for rapid changes (on the order of a few weeks) in the earth's rate of rotation. The major contributor to the USNO UT1-UTC is the connected element interferometer. It is imperative that the present sources continue to be available to USNO for input to the system, and highly desirable that additional high-precision, reliable sources be added. D.H.

A86-29451#

CONTINENTAL SCALE BASELINES DETERMINED BY VLBI

D. S. ROBERTSON and W. E. CARTER (NOAA, National Geodetic Survey, Rockville, MD) IN: International Symposium on Space Techniques for Geodynamics, Sopron, Hungary, July 9-13, 1984, Proceedings. Volume 2. Sopron, Hungary, Magyar Tudomanyos Akademia Geodeziai es Geofizikai Kutato Intezet, 1984, p. 17-24.

An account is given of very-long-baseline-interferometry (VLBI) observations made by the IRIS (International Radio Interferometric Surveying) project to monitor polar motion and earth rotation. Such observations have been made since the beginning of 1984 every five days, using the three POLARIS Stations in the United States and the Wettzell Observatory in the Federal Republic of Germany

03 GEODESY AND CARTOGRAPHY

(Carter & Robinson, 1984). The Onsala Space Observatory in Sweden has also participated about once a month. These observations demonstrate that geodetic VLBI, using the MARK III system, routinely achieves a repeatability (RMS) on baselines ranging from 2000 to 800 km of about one part in 10 to the 8th from observing sessions of 24 hr duration. D.H.

A86-29452#

BASILINE OBSERVATIONS USING A TRIANGLE OF SATELLITES

H. DREWES (Deutsches Geodaetisches Forschungsinstitut, Munich, West Germany) IN: International Symposium on Space Techniques for Geodynamics, Sopron, Hungary, July 9-13, 1984, Proceedings. Volume 2. Sopron, Hungary, Magyar Tudomanyos Akademia Geodeziai es Geofizikai Kutato Intezet, 1984, p. 25-32.

Reflections are presented on a satellite system which allows instantaneous measurements of the baselength between two terrestrial stations for real time surveying of high precision baseline determinations for geodynamic research. The capability of such a system is studied for two typical application fields: (1) surveying of first-order control networks (continental networks) or monitoring recent crustal movements (maximum baselength of some 100 km) and (2) worldwide surveying of global networks or geodynamic research (plate kinematics). The system is based on purely geometrical mode and provides accuracies of the length of the baselines at the centimeter level after one pass observation time (a few minutes). Its major advantage is that precise orbit determination is not necessary - which at the outset excludes error sources such as gravity field, drag, polar motion, and other orbit-dependent effects. D.H.

N86-18881# Analytic Sciences Corp., Reading, Mass.
ANALYSIS AND SIMULATION OF MULTISENSOR GRAVITY SURVEYS: VOLUME 1 Final Report, Jun. 1977 - Mar. 1981

J. D. GOLDSTEIN 15 Apr. 1985 171 p
(Contract F19628-77-C-0152)
(AD-A160388; TR-4423-4; AFGL-TR-81-0018(1)) Avail: NTIS HC A08/MF A01 CSCL 08E

A new general methodology is developed for the determination of the statistics of multisensor survey residual gravity. The method is ideally suited for the design of multisensor surveys to achieve a desired level of gravity recovery accuracy. Survey types considered consist of any combination of satellite radar altimetry, high-low satellite-to-satellite tracking, shipborne or land-based gravimetry and airborne gravimetry. Several examples of the results obtained with the methodology are included. Author (GRA)

N86-19708 New South Wales Univ., Kensington (Australia). School of Surveying.

THE COMBINATION OF VLBI AND GROUND DATA FOR GEODESY AND GEOPHYSICS Ph.D. Thesis Abstract Only

B. R. HARVEY Feb. 1985 2 p
Avail: Issuing Activity

An analytical procedure for the combination of VLBI and geodetic survey measurements and their evaluation and comparison was developed. Crustal deformation analysis, comparisons between space techniques, and the strengthening of geodetic networks are the main applications. The VLBI analysis is reviewed and the variance covariance matrix of the observables is investigated. The effects of systematic errors, particularly biases in the tropospheric corrections, on VLBI results are investigated and classified. The results of the first geodetic VLBI experiment within Australia are presented and their accuracies estimated. A method which combines VLBI and ground data by estimating the transformation parameters relating the preadjusted coordinates of the points of each network is recommended. Methods for studying regional strain are discussed. Several models for 2D and 3D strain are examined. It is recommended that VLBI and ground data be combined at each epoch. Any strain detected is not due to crustal movements. If no significant strain is detected, then the geophysical strain between these epochs can be determined. E.A.K.

N86-19710 New South Wales Univ., Kensington (Australia). **INTEGRATION OF DOPPLER POSITIONING INTO THE GEODETIC NETWORK OF INDONESIA Abstract Only**

C. HAFIDIN 1984 3 p

Avail: Issuing Activity

The Doppler satellite terrestrial coordinate determination was used to establish large control networks and reinforcing existing networks of horizontal control surveys. The preliminary network of Sumatra, Jawa and Nusa Tenggara consists of 407 stations of basically first and second order triangulation. Seventeen Doppler positions are distributed over the network. The preliminary combined adjustments of the Sumatra, Jawa and Nusa Tenggara primary horizontal networks were tested. The adjustments were carried out using the program CHAOS and the method for adjusting networks in sections. This method is mathematically similar to the Helmert block adjustment. The transformation parameters, from the Doppler System (WGS-72) into the terrestrial system (GRS-67) were determined using the PARM program, which follows the Bursa model transformation. The adjusting and transformation results are analyzed and Systematic differences between Doppler and terrestrial networks are noted. E.A.K.

N86-21968*# Southern Methodist Univ., Dallas, Tex. Dept. of Geological Sciences.

CONSTRAINTS ON LITHOSPHERIC STRUCTURE FROM SATELLITE POTENTIAL FIELD DATA: AFRICA AND ASIA. ANALYSIS AND INTERPRETATION OF MAGSAT ANOMALIES OVER NORTH AFRICA Final Technical Report, 1 Mar. 1983 - 31 May 1985

R. J. PHILLIPS 1986 104 p refs

(Contract NAG5-298)

(NASA-CR-176611; NAS 1.26:176611) Avail: NTIS HC A06/MF A01 CSCL 08G

Crustal anomaly detection with MAGSAT data is frustrated by the inherent resolving power of the data and by contamination from the external and core fields. The quality of the data might be tested by modeling specific tectonic features which produce anomalies that fall within the proposed resolution and crustal amplitude capabilities of the MAGSAT fields. To test this hypothesis, the north African hotspots associated with Ahaggar, Tibestia and Darfur have been modeled as magnetic induction anomalies due solely to shallower depth to the Curie isotherm surface beneath these features. The MAGSAT data were reduced by subtracting the external and core fields to isolate the scalar and vertical component crustal signals. The predicted model magnetic signal arising from the surface topography of the uplift and the Curie isotherm surface was calculated at MAGSAT altitudes by the Fourier transform technique modified to allow for variable magnetization. In summary it is suggested that the region beneath Ahaggar is associated with a strong thermal anomaly and the predicted anomaly best fits the associated MAGSAT anomaly if the African plate is moving in a northeasterly direction. Author

04

GEOLOGY AND MINERAL RESOURCES

Includes mineral deposits, petroleum deposits, spectral properties of rocks, geological exploration, and lithology.

A86-19495

SYNERGISTIC VALUE OF INTERPRETING IMAGERY OF VARIOUS SCALES FOR OIL AND MINERAL EXPLORATION

L. E. BOGART (Geological and Exploration Associates, Port Townsend, WA) and L. A. READDY (Geological and Exploration Associates, Kirkland, WA) IN: Recent advances in civil space remote sensing; Proceedings of the Meeting, Arlington, VA, May 3, 4, 1984. Bellingham, WA, SPIE - The International Society for Optical Engineering, 1984, p. 34-42. refs

A86-19496

SATELLITE REMOTE SENSING FOR ALUMINUM AND NICKEL LATERITES

F. B. HENDERSON, III (Geosat Committee, San Francisco, CA), G. T. PENFIELD (Western Geophysical Company of America, Aero Service Div., Houston, TX), and D. K. GRUBBS (Aluminum Company of America, Alcoa Center, PA) IN: Recent advances in civil space remote sensing; Proceedings of the Meeting, Arlington, VA, May 3, 4, 1984. Bellingham, WA, SPIE - The International Society for Optical Engineering, 1984, p. 43-51. Research supported by the Aluminum Company of America and Western Geophysical Company of America. refs

The use of Landsat Thematic Mapper (TM) data to explore for aluminum and nickel laterites is discussed. Nickel laterites on Gas Island, Indonesia are defined by MSS imagery. In addition, satellite imagery of the Cape Bougainville and the Darling range, Australia bauxite deposits shows the potential use of MSS data for exploration and mining applications. Examples of satellite SAR data for Jamaica are found to document the use of this method for bauxite exploration. Finally, attention is given to the combination of TM data with SPOT satellite data and SAR data to assist with the logistics, mine development, and environmental concerns connected with aluminum and nickel lateritic deposits worldwide.

B.J.

A86-19497

THE LEELANAU, BENZIE AND GRAND TRAVERSE, MICHIGAN ANOMALIES STRUCTURAL AND GEOBOTANICAL INDICATORS OF HYDROCARBON MICROSEEPAGE

R. J. STASKOWSKI (Earth Satellite Corp., Chevy Chase, MD) IN: Recent advances in civil space remote sensing; Proceedings of the Meeting, Arlington, VA, May 3, 4, 1984. Bellingham, WA, SPIE - The International Society for Optical Engineering, 1984, p. 52-60. refs

The paper examines relationships between structural and geobotanical anomalies observed on Landsat and Seasat imagery and believed to be related to hydrocarbon microseepage and previously recorded subsurface geophysical, stratigraphic, and structural anomalies. The integration of these surface anomalies with regional cross sections and geophysical studies show that they lie along predictable subsurface trends. These trends control hydrocarbon migration and accumulation; anomalies occur in both producing and untested portions of the trends. It is noted that, while the proposed approach does not define specific exploration targets, it does provide an excellent regional perspective and helps to narrow-down prospective areas.

B.J.

A86-20690#

THE APPLICATION OF SPATIAL INFORMATION TECHNOLOGY TO PETROLEUM RESOURCE ASSESSMENT ANALYSIS

B. M. MILLER and M. A. DOMARATZ (USGS, National Center, Reston, VA) IN: Spatial information technologies for remote sensing today and tomorrow; Proceedings of the Ninth Pecora Symposium, Sioux Falls, SD, October 2-4, 1984. Silver Spring, MD, Institute of Electrical and Electronics Engineers, Inc., 1984, p. 303-310. refs

Petroleum resource assessment procedures require the analysis of a large volume of spatial data. The U.S. Geological Survey (USGS) has developed and applied spatial information handling procedures and digital cartographic techniques to a recent study on the assessment of oil and gas resource potential for 74 million acres of designed and proposed Wilderness Lands in the Western United States. A method was designed to expedite the gathering, integrating, managing, manipulating and plotting of spatial data from multiple data sources that are essential in modern resource assessment procedures.

Author

A86-20695

IMAGE PROCESSING FOR DATA INTEGRATION IN MINERAL AND PETROLEUM EXPLORATION

S. ARONOFF and D. HAWKINS (Dipix Systems, Ltd., Ottawa, Canada) IN: Spatial information technologies for remote sensing today and tomorrow; Proceedings of the Ninth Pecora Symposium, Sioux Falls, SD, October 2-4, 1984. Silver Spring, MD, Institute of Electrical and Electronics Engineers, Inc., 1984, p. 346-356.

Successful mineral and petroleum exploration requires that diverse data be effectively integrated. Multi-million dollar exploration programs depend on the ability of exploration geologists to analyze interrelated data sets and recognize sites sufficiently promising to justify investment in more detailed surveys or exploratory drilling. The power and speed of an image processing system to manipulate data sets allows the geologist the time to progressively refine an analysis. These techniques are illustrated using two examples. In Example One, Landsat digital data, geochemical, and aeromagnetic data for the Nabesna area of Alaska is integrated with existing maps. Example Two shows data integration applied to the interpretation of seismic data.

Author

A86-20702#

MONITORING FEDERAL MINERALS WITH THE USE OF LANDSAT ALBEDO DIFFERENCE AND ANCILLARY DATA

R. E. ARNDT (U.S. Bureau of Land Management, Washington, DC) IN: Spatial information technologies for remote sensing today and tomorrow; Proceedings of the Ninth Pecora Symposium, Sioux Falls, SD, October 2-4, 1984. Silver Spring, MD, Institute of Electrical and Electronics Engineers, Inc., 1984, p. 406-408.

BLM utilizes Landsat data together with a multilayered GIS to monitor changes on potentially valuable Federal mineral lands in the eastern United States. A multilayered screening process begins with thresholding the change data and ends with field verification in order to screen out the brightness changes unrelated to mining on or near Federal minerals. A RIPS image processing microcomputer is used to display segments of each project area GIS and to develop the threshold statistics to be applied over each entire project area.

Author

A86-21154#

EVALUATION OF THE CONTRIBUTION OF SATELLITE DATA TO GEOLOGICAL MAPPING

P. DUTARTRE, C. KING, and D. ROUSSELOT (Bureau de Recherches Geologiques et Minieres, Orleans, France) IN: International Symposium on Remote Sensing of Environment, 18th, Paris, France, October 1-5, 1984, Proceedings. Volume 1. Ann Arbor, MI, Environmental Research Institute of Michigan, 1985, p. 581-593. refs

The assistance contributed by preliminary use of SPOT data and Landsat MSS data to the medium-scale stages (1:25,000 to 1:100,000) of prospecting and systematic surveying was evaluated by comparison with ground radiometric data, a SPOT simulation acquired in winter conditions, and a 1:50,000 geological map prepared by standard mapping methods. The test areas were the Beauce (SPOT evaluation) and Valence (Landsat MSS evaluation) regions in France. The two basic assets of spatial remote sensing data are recognition of homogeneous areas with common spectral characteristics and the possibility of determining an overall structural system. Selective processing operations bring out the close correspondence between the spatial variation in ground surface reflectance and the distribution of the main surficial units.

I.S.

A86-21193#

A STRATEGY FOR IMPLEMENTING REMOTE SENSING IN EXPLORATION GEOLOGY - APPLICATION TO THE ARMORICAN MASSIF (FRANCE)

J.-Y. SCANVIC (Bureau de Recherches Geologiques et Minieres, Orleans, France) IN: International Symposium on Remote Sensing of Environment, 18th, Paris, France, October 1-5, 1984, Proceedings. Volume 2. Ann Arbor, MI, Environmental Research Institute of Michigan, 1985, p. 1113-1118. refs

04 GEOLOGY AND MINERAL RESOURCES

A86-21194#

A REMOTE SENSING STUDY OF A SECTOR COLLAPSE VOLCANO (SOCOMPA, N CHILE)

D. A. ROTHERY and P. W. FRANCIS (Open University, Milton Keynes, England) IN: International Symposium on Remote Sensing of Environment, 18th, Paris, France, October 1-5, 1984, Proceedings. Volume 2. Ann Arbor, MI, Environmental Research Institute of Michigan, 1985, p. 1119-1128. refs

A86-21213#

CHARACTERIZATION OF SPECTRAL SIGNATURES OF ALUMINOUS FORMATIONS (LATERITES AND BAUXITES) - POSSIBILITIES OF USING SATELLITE REMOTE SENSING FOR PROSPECTING FOR ALUMINOUS MINERALS

P. BILDGEN, J. BOULEGUE (Paris VI, Université, Paris, France), and A. SIMONIN (CNRS, Centre d'Études et de Réalisations Cartographiques Géographiques, Paris, France) IN: International Symposium on Remote Sensing of Environment, 18th, Paris, France, October 1-5, 1984, Proceedings. Volume 3. Ann Arbor, MI, Environmental Research Institute of Michigan, 1985, p. 1383-1392. refs

The present paper is concerned with the problem of spectral characterization of aluminous lateritic rocks and bauxites, taking into account possibilities for the utilization of satellite data in prospecting for aluminous minerals. Previous studies are discussed, and the geological data of selected test-sites are considered. Attention is given to Haitian test-sites, test-sites in the southeast of France, and the conduction of laboratory and field studies. The analysis of spectrophotographic data and in situ field data shows clearly that in the spectral regions presently used by satellite sensors of the type employed by Landsat, only the occurrence of iron can be detected. A differentiation between aluminous kaolinic rocks and red sediments with a high content of aluminum hydroxides (bauxites) cannot be achieved on the basis of data obtained in this spectral region. However, the employment of new sensors, such as the Thematic Mapper, will improve possibilities for the differentiation. G.R.

A86-21237#

USE OF SATELLITE REMOTE SENSING FOR THE STRATEGIC AND TACTICAL PROSPECTION OF NON-OUTCROPPING GRANITIC APEXES - APPLICATION TO TIN-TUNGSTEN DEPOSITS [LA TELEDETECTION SPATIALE, UN MOYEN DE PROSPECTION STRATEGIQUE ET TACTIQUE DES APEX GRANITQUES NON AFFLEURANTS EXEMPLE D'APPLICATION AUX GISEMENTS ETAIN-TUNGSTENE]

B. MARCONNET and CL. CAGNY (Nancy I, Université, Vandœuvre-les-Nancy, France) IN: International Symposium on Remote Sensing of Environment, 18th, Paris, France, October 1-5, 1984, Proceedings. Volume 3. Ann Arbor, MI, Environmental Research Institute of Michigan, 1985, p. 1645-1655. In French. refs

A86-21262#

APPLICATIONS OF DIGITAL IMAGE ENHANCEMENT IN REGIONAL TECTONIC MAPPING OF SOUTH INDIA

S. A. DRURY (Open University, Milton Keynes, England) IN: International Symposium on Remote Sensing of Environment, 18th, Paris, France, October 1-5, 1984, Proceedings. Volume 3. Ann Arbor, MI, Environmental Research Institute of Michigan, 1985, p. 1895-1904. Research supported by the Open University. refs (Contract NSERC-GR/3/3665)

Regional tectonic modeling of complex Precambrian basement terrains is possible using a combination of mosaiced standard EDC photographic Landsat images, enhanced digital Landsat images and synergistic field traverses and mapping. The main provisos are the presence of residual soils, geological control over natural vegetation and careful selection of the dates of imagery. Tropical seasonal climates are favorable, as exemplified by the terrain of South India. Greatest structural information is provided by principal component analysis of Landsat MSS data and suitable edge enhancement. Such techniques are applied here to tectonic

features of the Archaean and Proterozoic evolution of the South Indian craton. Author

A86-21263#

EXAMPLES OF AIRBORNE THERMAL INFRARED ANALYSIS APPLIED TO ENGINEERING GEOLOGY AND CIVIL WORKS SITE INVESTIGATIONS

C. M. MARINO, G. DEL PERO (Milano, Università, Milan, Italy), and A. M. TONELLI (Luigi Rossi ARCO, Milan, Italy) IN: International Symposium on Remote Sensing of Environment, 18th, Paris, France, October 1-5, 1984, Proceedings. Volume 3. Ann Arbor, MI, Environmental Research Institute of Michigan, 1985, p. 1905-1914. refs

Results obtained in some projects are demonstrated in order to assist geologists and engineers in determining and identifying particular surface phenomena detected in remotely sensed imagery. The phenomena are related, after ground truth investigations, to the presence of particular geologic or hydrogeologic events. Two examples of thermal infrared analysis are described: subsurface discontinuities detection (and related problems) and location of embankment leakage. D.H.

A86-21264#

REMOTE SENSING AND SUBSURFACE ANOMALIES IN THE BRESSE REGION OF FRANCE

F. BENARD, G. GESS, C. LALLEMAND, A. MARIE (Institut Français du Pétrole, Rueil-Malmaison, France), P. DUTARTRE (Bureau de Recherches Géologiques et Minières, Orléans, France) et al. IN: International Symposium on Remote Sensing of Environment, 18th, Paris, France, October 1-5, 1984, Proceedings. Volume 3. Ann Arbor, MI, Environmental Research Institute of Michigan, 1985, p. 1915-1927. refs

An account is given of a study attempting to explain large scale lineaments and curvilinear phenomena seen on Landsat images of the Bresse region of France. The presence of the lineaments and phenomena cannot be explained by the surface geology (which consists mainly of cover deposits). A joint analysis of remote-sensing data and geophysical data (gravimetry) was conducted. Numerical techniques for creating composite images are discussed, along with the geological interpretations. A detailed analysis is given of an area where this method has revealed an impact of the morphology of the substratum on the overlying formations. D.H.

A86-21593

AIRBORNE GEOPHYSICS FOR GEOLOGICAL MAPPING AND REGIONAL EXPLORATION

C. V. REEVES (International Institute for Aerial Survey and Earth Sciences, Enschede, Netherlands) ITC Journal (ISSN 0303-2434), no. 3, 1985, p. 147-161. refs

Many countries already have or are planning to obtain complete national coverage of aeromagnetic surveys, often combined with airborne gamma-ray spectrometer and/or electromagnetic data. These surveys are usually designed to support and stimulate exploration by providing basic geophysical information to supplement existing geological maps. Large quantities of useful data are generated. Maximum benefit accrues where the geophysical data are: (1) freely published, (2) subjected to a thorough qualitative and quantitative interpretation, and (3) fully integrated with the existing geologic database for the country. The successful execution of (2) and (3) depends on obtaining a skillful balance between geophysical rigor and geological intuition. The process involves mechanical analysis of numerous anomalies, a somewhat subjective zoning of anomaly patterns, and an appropriate degree of respect for the available geologic information. Examples from several countries are used to demonstrate this, and some areas where new tools for the interpreter could improve his effectiveness are suggested as practical ITC research topics. Author

A86-21594

THE LUMINEX METHOD - A NEW GEOPHYSICAL METHOD FOR AIRBORNE AND GROUND PROSPECTING FOR ORE DEPOSITS

H. O. SEIGEL and J. C. ROBBINS (Scintrex, Ltd., Concord, Canada) ITC Journal (ISSN 0303-2434), no. 3, 1985, p. 162-168. Research supported by Rio Tinto Canadian Exploration, Ltd.

A new method for prospecting for minerals has been developed by a Canadian company based on the luminescence of minerals when exposed to an ultraviolet light source. Certain key minerals which are ore minerals themselves or frequently accompany other minerals can be detected from the air or with hand-held equipment on the ground. This extends the remotely detectable minerals to include tungsten, tin, molybdenum, gold and lead-zinc. The most important limitation of the method is that the minerals must be exposed, i.e., without soil or vegetation cover. Author

A86-21596

REPORT ON THE RESULTS IN GEOLOGY AND GEOMORPHOLOGY OF THE EUROPEAN SAR-580 EXPERIMENT

B. N. KOOPMANS (International Institute for Aerial Survey and Earth Sciences, Enschede, Netherlands) ITC Journal (ISSN 0303-2434), no. 3, 1985, p. 203-206. refs

Image data from a synthetic aperture radar (SAR) experiment are presented. The SAR operated in X/C and X/L band modes. The importance of the orientation of the slope facets with respect to radar look direction and depression angle in interpreting terrain morphology is analyzed. The tone, texture, pattern, and shape of the radar images are used to interpret the morphology and develop a geologic/geomorphologic model. The test sites and data processing of the images are described. It is concluded that the SAR data are useful for the study of drainage, geological structures, lineaments, and mineral occurrence; however, the data are not applicable to morphology and lithology. Areas of continued research are discussed. I.F.

A86-22555

THE TECTONICS OF SUBSALT DEPOSITS ACCORDING TO THE RESULTS OF A NUMERICAL ANALYSIS OF SPACE IMAGES OF THE WESTERN PART OF THE CASPIAN BASIN [TEKTONIKA PODSOLEVYKH OTLOZHENII PO REZUL'TATAM DESHIFIROVANIYA KOSMICHESKIKH SNIMKOV ZAPADNOI CHASTI PRIKASPIISKOI VPADINY]

V. F. MOKIENKO (Volgogradskii Gosudarstvennyi Nauchno-Issledovatel'skii i Proektnyi Institut Neftianoi Promyshlennosti, Volgograd, USSR) Issledovanie Zemli iz Kosmosa (ISSN 0205-9614), Sept.-Oct. 1985, p. 44-52. In Russian. refs

A86-22556

THE GEOLOGY OF THE BAYANUL RING STRUCTURE (CENTRAL MONGOLIA) INFERRED FROM SPACE IMAGES [GEOLOGICHESKAIA PRIRODA BAIANUULSKOI KOL'TSEVOI STRUKTURY /TSENTRAL'NAIA MONGOLIYA/, VYIAVLENNOI PO KOSMICHESKIM SNIMKAM]

P. KHOSBAIAR and S. ARIUNBILEG (Academy of Sciences, Institute of Geology, Ulan Bator, Mongolian People's Republic) Issledovanie Zemli iz Kosmosa (ISSN 0205-9614), Sept.-Oct. 1985, p. 53-57. In Russian. refs

A86-22832

EVALUATION OF SPOT SIMULATOR DATA FOR GEOLOGIC MAPPING IN THE SPLIT MOUNTAIN REGION, UTAH COUNTY, UTAH

G. B. BAILEY (USGS, Sioux Falls, SD) and J. L. DWYER (Technicolor Government Services, Inc., Sioux Falls, SD) IN: SPOT simulation applications handbook; Proceedings of the SPOT Symposium, Scottsdale, AZ, May 20-23, 1984. Falls Church, VA, American Society of Photogrammetry, 1984, p. 47-55. (Contract USGS-14-08-0001-20129)

SPOT simulator data collected over the Split Mountain anticline were digitally enhanced and studied to evaluate their utility for

geologic mapping. Band ratioing, principal components analysis, and color space transformation techniques were applied to the data, and resultant images were manually analyzed and interpreted to define the types and amount of geologic information provided. Enhanced SPOT simulator images and the corresponding geologic interpretations were evaluated in comparison with similarly enhanced and interpreted thematic mapper simulator imagery acquired over the same area. Results indicate that SPOT simulator data provide a marked improvement in the level of detail with which the sedimentary rock units in the study area can be mapped. Author

A86-22833

DIGITAL PROCESSING OF SPOT SIMULATOR AND LANDSAT TM DATA FOR THE SP MOUNTAIN REGION, ARIZONA

P. S. CHAVEZ, JR. and G. L. BERLIN (USGS, Flagstaff, AZ) IN: SPOT simulation applications handbook; Proceedings of the SPOT Symposium, Scottsdale, AZ, May 20-23, 1984. Falls Church, VA, American Society of Photogrammetry, 1984, p. 56-66. refs

SPOT simulator images were digitally processed and compared with certain Landsat-4 Thematic Mapper (TM) images depicting the volcanic and sedimentary terrain of the SP Mountain region, Arizona. The image data sets were subjected to the following enhancement algorithms: edge enhancement, high-pass spatial filtering with n percent addback of the original data, directional first differencing, and principal components (PC) analysis. Although statistical comparisons reveal that more radiometric or color information is present in certain triple TM band combinations than in the three SPOT bands, the SPOT-PC color-composite image proved to be useful for identifying many different surface materials. Because of SPOT's more favorable resolution, its images contain the highest level of terrain detail. Author

A86-22835

REVIEW OF SPOT IMAGERY SIMULATION AT THE COPPER CANYON CU-AU MINING AREA, LANDER COUNTY, NEVADA

R. A. METZ (Duval Corp., Tucson, AZ), D. W. BLAKE, and P. R. WOTRUBA (Duval Corp., Battle Mountain, NV) IN: SPOT simulation applications handbook; Proceedings of the SPOT Symposium, Scottsdale, AZ, May 20-23, 1984. Falls Church, VA, American Society of Photogrammetry, 1984, p. 83-91. refs

The Copper Canyon Mining Area, about 16 km southwest of the town of Battle Mountain, Nevada, has a 120-year history of base and precious metal mining responsible for the production of over 180,000 short tons of copper, 1,000,000 oz. gold, 7,000,000 oz. silver. Geology of the area consists mainly of complexly faulted Paleozoic sedimentary and volcanic rocks cut by Tertiary intrusives and locally overlain by Tertiary and Quaternary volcanics. Mineral deposits related to the Tertiary intrusives include porphyry copper-gold-silver and molybdenum systems, disseminated and skarn type gold-silver bodies, gold-silver and lead-zinc-silver veins. The SPOT Imagery simulation covers an area approximately 5 x 12 km over the Copper Canyon copper-gold deposit and extends to the Copper Basin disseminated molybdenite deposit, including a number of the vein systems mentioned above. In addition to mining-related cultural features, recognizable features on the imagery products discussed included various vegetation types, rock types, significant fault traces, and alteration haloes. Author

A86-22849

USE OF SIMULATED SPOT DATA FOR THE EVALUATION OF LANDSCAPE STABILITY IN A SEMI-ARID REGIONK. F. CONNORS, T. W. GARDNER, G. W. PETERSEN, J. R. EYTON, and G. M. BAUMER (Pennsylvania State University, University Park) IN: SPOT simulation applications handbook; Proceedings of the SPOT Symposium, Scottsdale, AZ, May 20-23, 1984. Falls Church, VA, American Society of Photogrammetry, 1984, p. 220-228. refs
(Contract DE-AC02-83ER-60182)

Simulated SPOT data resolved complex landscape components near a deep uranium mine and milling operation in northwestern New Mexico. Landscape components and their stability must be determined to identify safe storage sites for uranium tailings.

Landscape stability is related to soil surface texture, vegetation cover, landscape position, and the interaction of these characteristics with surficial geomorphic processes. The CLUS program was used to cluster subsets of the simulated SPOT data to determine unsupervised feature signatures. Field investigations conducted in 1983 in conjunction with aerial photograph interpretation provided ground truth for signature identification. Using the CLASS program to classify a portion of the scene, it was possible to discriminate between stable, eolian-mantled uplands; metastable, intermediate surfaces with exposed B-horizons, salt pans and coppice dunes; unstable, fine-grained alluvial fills; and wet, well vegetated alluvial fills. The intensity-hue-saturation image displays these landscape components, clearly distinguishing between stable uplands, complex metastable intermediate surfaces, and unstable valley floors. Author

A86-24615
A MORPHO-STRUCTURAL ANALYSIS OF THE NORMANDY COPSE FROM THE SPACELAB-1 MISSION IRC PHOTOGRAPHS - WINTER PHOTOGRAPHS, STS-9 FLIGHT OF 2-12-1983 [INTERPRETATION MORPHO-STRUCTURALE DU BOCAGE NORMAND A PARTIR DE PHOTOS I.R.C. DE LA MISSION SPACELAB-1 - PHOTOGRAPHIES D'HIVER, VOL STS-9 DU 02.12.1983]
 M. HELLUIN and J. PELLERIN (CNRS, Centre de Geomorphologie, Caen, France) Societe Francaise de Photogrammetrie et de Teledetection, Bulletin (ISSN 0244-6014), no. 99, 1985, p. 27-33. In French. refs

A86-25499
TRANSFORMATION OF GEOLOGICAL-GEOPHYSICAL AND HYPSONETRIC MAPS WITH THE AIM OF IDENTIFYING PSEUDOCIRCULAR ANOMALIES (FORMS) FOR AUTOMATING THE INTERPRETATION OF RING STRUCTURES ON SPACE PHOTOGRAPHS [TRANSFORMIROVANIIE GEOLOGO-GEOFIZICHESKIKH I GIPSOMETRICHESKIKH KART S TSEL'IU VYDELENIYA PSEVDOKRUGOVYKH ANOMALII (FORM) DLIYA AVTOMATIZATSII PROTSESSA DESHIFIROVANIYA KOL'TSEVYKH STRUKTUR NA KOSMICHESKIKH SNIMKAKH]
 A. T. ZVEREV and A. I. STRYKOV (Moskovskii Institut Inzhenerov Geodezii, Aerofotos'emki i Kartografii, Moscow, USSR) Geodeziia i Aerofotos'emka (ISSN 0536-101X), no. 5, 1985, p. 46-54. In Russian.

A86-26317* Jet Propulsion Lab., California Inst. of Tech., Pasadena.
MULTIPOLARIZATION RADAR IMAGES FOR GEOLOGIC MAPPING AND VEGETATION DISCRIMINATION
 D. L. EVANS, T. G. FARR, J. P. FORD, T. W. THOMPSON, and C. L. WERNER (California Institute of Technology, Jet Propulsion Laboratory, Pasadena) IEEE Transactions on Geoscience and Remote Sensing (ISSN 0196-2892), vol. GE-24, March 1986, p. 246-257. NASA-supported research. refs
 NASA has developed an airborne SAR that simultaneously yields image data in four linear polarizations in L-band with 10-m resolution over a swath of about 10 km. Signal data are recorded both optically and digitally and annotated in each of the channels to facilitate completely automated digital correlation. Comparison of the relative intensities of the different polarizations furnishes discriminatory mapping information. Local intensity variations in like-polarization images result from topographic effects, while strong cross polarization responses denote the effects of vegetation cover and, in some cases, possible scattering from the subsurface. In each of the areas studied, multiple polarization data led to the discrimination and mapping of unique surface unit features. O.C.

A86-27673
STRUCTURES OF CONTINENTAL AND TRANSITIONAL CRUST ON SPACE PHOTOGRAPHS [STRUKTURY KONTINENTAL'NOI I PEREKHODNOI ZEMNOI KORY NA KOSMICHESKIKH SNIMKAKH]
 N. I. FILATOVA, I. V. EGOROV, A. I. DVORIANKIN, A. P. DOROGUTIN, and I. A. KUZNETSOVA Moscow, Izdatel'stvo Nedra, 1984, 212 p. In Russian. refs
 The work demonstrates the possibility of using space remote-sensing images to obtain geological information about areas of the earth surface with different types of crustal structure. Photointerpretation techniques are described, and the relationship between ore deposits and crustal structures is examined. Particular consideration is given to the use of space images to study: the tectonics of the continent-ocean transition zone in the northeastern USSR; endogenic ring structures of the transitional zone; the continental crust of the pre-Riplean period, partly destroyed in the Paleozoic and Mesozoic; and the transitional crust formed in the late Mesozoic and Cenozoic. B.J.

N86-16702# New Mexico State Univ., Las Cruces. Energy Inst.
AN EVALUATION OF THERMAL REMOTE SENSING AS A LOW-COST REGIONAL GEOTHERMAL EXPLORATION TECHNIQUE IN NEW MEXICO Final Report
 J. WHITTIER, M. INGLIS (New Mexico Univ., Albuquerque), and T. K. BUDGE (New Mexico Univ., Albuquerque) Mar. 1985 53 p
 (DE85-901266; NMERDI-2-71-4221) Avail: NTIS HC A04/MF A01

Airborne and satellite borne thermal infrared scanner data were analyzed for application in the exploration of geothermal resources in New Mexico. The location for this study was the East Mesa Geothermal Field near Las Cruces, New Mexico. Primary sensor was the Thermal Infrared Multispectral Scanner (TIMS) which obtained data at 10-meter resolution. Additional data for comparison came from the Heat Capacity Mapping Mission (HCMM) satellite which provided data at 600-meter resolution. These data were compared to the soils, vegetation, and geology of the area, as well as borehole temperature data in an attempt to explain temperature patterns and anomalies. Thermal infrared scanner data were found to be too sensitive to solar-induced temperature anomalies to directly reflect the presence of subsurface geothermal anomalies but may provide valuable supporting information for a geothermal exploration program. DOE

N86-17935# Pacific Northwest Lab., Richland, Wash.
ADVANCED TECHNIQUES FOR LITHOLOGIC AND FRACTURE ANALYSIS UTILIZING THEMATIC MAPPER AND TOPOGRAPHIC DATA
 H. P. FOOTE, R. L. THIESSEN, J. R. ELIASON, and G. E. WUKELIC Jun. 1985 12 p. refs Presented at the NASA LIDQU Final Symposium: LANDSAT Image Data Quality Analysis Meeting, Indianapolis, Ind., 9 Sep. 1985 Prepared in cooperation with Washington State Univ., Pullman
 (Contract DE-AC06-76RL-01830)
 (DE85-018220; PNL-SA-13290; CONF-8509161-2) Avail: NTIS HC A02/MF A01

Under the LIDQA program, the Pacific Northwest Laboratory has been evaluating selected energy-related applications of the LANDSAT Thematic Mapper (TM) data from a user-agency perspective. This paper describes techniques that have been developed to correct for topographic-induced shading on TM surface reflectance and to perform topographic analysis to define crustal fracture zones as aids to geologic studies. These techniques require the use of only digital terrain and TM data. The analysis techniques have been successfully applied to the Paiute Ridge Quadrangle in Nevada, demonstrating the utility of the techniques for geologic studies. DOE

N86-18380# Centre National de la Recherche Scientifique, Valbonne (France). Centre de Recherches Archeologiques.
REMOTE SENSING AND ARCHAEOLOGICAL RESEARCH IN THESSALY, GREECE. NEW PROSPECTS IN ARCHAEOLOGICAL LANDSCAPE
 E. BARISANO and B. HELLY *In* ESA Proceedings of EARSeL/ESA Symposium on European Remote Sensing Opportunities: Systems, Sensors, and Applications p 203-209 Jun. 1985 refs
 Avail: NTIS HC A12/MF A01

The use of satellite data in archaeological research in Thessaly (Greece) in a methodological study to determine the interpretation processes concerning spatial imagery is described. The study involved determining the physical factors in order to understand the ancient spatial organization in the lower Enipeus valley, connected with the distribution and density of identified sites with signs of human occupation. An archaeological prospection strategy was formulated from spectral, textural, and structural indicators deduced from satellite data in the eastern plain of Larisa (ancient lake Karla).
 Author (ESA)

N86-18382# Milan Univ. (Italy). Dept. of Earth Sciences.
LONG LINEAR FEATURES OBSERVED ON THE ALPINE OROGEN AND THEIR COMPARISON WITH SOME GEOPHYSICAL DATA
 R. CASSINIS, C. M. MARINO, and F. PINALI *In* ESA Proceedings of EARSeL/ESA Symposium on European Remote Sensing Opportunities: Systems, Sensors, and Applications p 217-219 Jun. 1985 refs
 Avail: NTIS HC A12/MF A01

A map of linear features observed on the Alpine orogen was drawn on 1:1,000,000 scale, using multitemporal and multispectral satellite imagery (MSS LANDSAT). The total field, containing linears with L or $= 15$ km, was filtered in length and azimuth, obtaining different maps (6 azimuthal and 1 of long linears with L or $= 50$ km). The filtered maps were compared with geophysical data having a similar uniformity of information and drawn on the same scale. All maps were analyzed according to geological domains. It is believed that the long linears are the surface reflection of deep crustal structures.
 Author (ESA)

N86-18383# Catania Univ. (Italy). Dept. of Engineering.
MONITORING OF GROUND FRACTURES CAUSED BY VOLCANIC ERUPTIONS USING REMOTE SENSING TECHNIQUES
 A. L. GERACI, G. LAROSA, T. CALTABIANO (CNR, Catania, Italy), and E. LOGIUDICE (CNR, Catania, Italy) *In* ESA Proceedings of EARSeL/ESA Symposium on European Remote Sensing Opportunities: Systems, Sensors, and Applications p 221-227 Jun. 1985 refs
 Avail: NTIS HC A12/MF A01

During the 1983 eruption of Mt Etna in Sicily, an investigation using remote sensing techniques was carried out over the southern side of the volcano to look at the linear development and the thermal behavior of ground fractures connected with active vents. The survey used thermal infrared imagery. It is proved that this kind of investigation makes it possible to locate thermal active fractures in the ground in active volcanic areas. It is possible to determine the length and direction of the fractures. It is also useful for the surveillance, study, and clearer representation of the eruption.
 Author (ESA)

N86-20238# Joint Publications Research Service, Arlington, Va.
GEOLOGICAL-GEOMORPHOLOGICAL INTERPRETATION OF PHOTO IMAGE PATTERNS IN SPACE PHOTOGRAPHS FOR WESTERN PART OF FERGANA VALLEY AND ITS MOUNTAINOUS FRAMEWORK Abstract Only
 D. MAGZUMOVA *In* its USSR Report: Space (JPRS-USP-86-001) p 135 13 Jan. 1986 Transl. into ENGLISH from Uzbekskiy Geologicheskii Zhurnal (Tashkent, USSR), no. 4, Jul. - Aug. 1985
 Avail: NTIS HC A03

A detailed analysis of photo image patterns was carried out using multizonal photographs at 1:1,000,000 obtained from the

LANDSAT satellite in four spectral ranges in the western part of the Fergana valley and the mountains surrounding it. With respect to geomorphological analysis of the patterns, the most informative photographs were obtained in the spectral zone 0.8-1.1 microns. The territory was represented by three major geomorphological types: mountainous uplifts, made up primarily of Palaeozoic deposits; adyr (desert plains without sands but with soft ground); and foothills consisting of Neogene and Lower- and Middle Quaternary deposits. On the basis of the photo image pattern it is possible to differentiate strongly, moderately and weakly dissected, undulating and flat surfaces. Flat and slightly undulating surfaces are interpreted on the basis of a geometrical or spotty pattern of cultivated landscapes; moderately dissected surfaces are discriminated on the basis of a jetlike pattern; well-dissected surfaces are discriminated from patterns form by adyr relief forms. Comparison of the interpreted photographs with Meteor photographs at 1:2,500,00 indicated that the latter reflect the nature of surface macrodissection. Their patterns are caused by relief megaforms associated with large geological structures. These photographs, at a larger scale, corresponded to the largest geomorphological regions. The photographs at 1,000,000, on the other hand, reflected lower-order structures.
 R.J.F.

N86-20241# Joint Publications Research Service, Arlington, Va.
GEOLOGICAL INFORMATION CONTENT OF MULTIZONAL PHOTOGRAPHS Abstract Only
 N. A. YAKOVLEV and S. G. SLUTSKAYA *In* its USSR Report: Space (JPRS-USP-86-001) p 139 13 Jan. 1986 Transl. into ENGLISH from Issledovaniye Zemli iz Kosmosa (Moscow, USSR), no. 2, Mar. - Apr. 1985 p 45-51
 Avail: NTIS HC A03

An evaluation is given for the several methods now in use for evaluating the geological information content of space photographs. Multizonal photographs must be evaluated primarily on the basis of the effectiveness of reflection of spectral criteria. In this method in discriminating the feature and identifying it the problem will be solved more successfully the greater the contrast between the images of the discriminated feature and the background (adjacent features). Contrast can be used as the principal index of comparative information content of multizonal images obtained in different survey channels. Definite procedures are given for determining contrast. It is concluded that there are no universally informative survey channels for discriminating the images of geological features on the basis of spectral criteria. The geological formation content of multizonal photographs as a whole and each survey channel separately can be evaluated only from the point of view of a specific problem.
 R.J.F.

N86-20242# Joint Publications Research Service, Arlington, Va.
GEOLOGICAL INFORMATION CONTENT OF SPACE PHOTOGRAPHS OBTAINED IN DIFFERENT SPECTRAL RANGES IN COURSE OF GOBI-KHANGAI EXPERIMENT (MUSHUGAY-GURVANBOGD TEST RANGE) Abstract Only
 V. I. MAKAROV and G. I. VOLCHKOVA *In* its USSR Report: Space (JPRS-USP-86-001) p 140 13 Jan. 1986 Transl. into ENGLISH from Issledovaniye Zemli iz Kosmosa (Moscow, USSR), no. 2, Mar. - Apr. 1985 p 52-58 Original language document was announced in IAA as A85-37118
 Avail: NTIS HC A03

The Gobi-Khangai experiment was carried out from aboard the Salyut-6 Soyuz-39 orbital complex by a Soviet-Mongolian crew in April 1981. A multizonal space photographic survey of the Mushugay-Khuduk region was made. This area is situated in the north-central part of the Gobi, directly to the east of Gurvan-Bogd Range in the Gobi Altai. Included are the results obtained in an earlier (June 1973) survey of this same territory from the ERTS-1 satellite under different illumination conditions. The availability of data from two surveys made it possible to analyze photographic conditions more fully than would have been possible on the basis of the results of only one survey. The strengths and weaknesses of the two surveys are compared. The space photographs served as an excellent base for compiling a map of Quaternary deposits far exceeding the accuracy of maps compiled by surface methods.

These photographs made possible a considerable upgrading of earlier published geological and tectonic maps. The comparative analysis of the geological content of space photographs obtained in different spectral ranges indicated that for visual interpretation under conditions similar to the Gobi Altai it is sufficient to have images in the spectral range 0.8 to 0.9 microns the range 0.6 to 0.7 microns can be recommended as an additional range. A need for other ranges would arise only for obtaining synthesized images.

Author

N86-20243# Joint Publications Research Service, Arlington, Va. **TECTONIC INTERPRETATION OF RESULTS OF INTERPRETATION OF SPACE PHOTOGRAPHS OF THE CAUCASUS Abstract Only**

G. A. MIKHEYEV and M. G. MAKAROVA *In its* USSR Report: Space (JPRS-USP-86-001) p 141 13 Jan. 1986 Transl. into ENGLISH from Issledovaniye Zemli iz Kosmosa (Moscow, USSR), no. 2, Mar. - Apr. 1985 p 59-66

Avail: NTIS HC A09

An extensive literature has already been devoted to the possibilities of space photographs of the Caucasus for the geological study of that region. These materials and published results of such work are reviewed and integrated. A full-page map shows the location of lineaments and structures of the central (annular) type in the Caucasus region; this map is used in describing the interpreted photographs. It is concluded that in the formation of the present-day tectonic plan a definite role is played by faults of sublatitudinal and northwesterly directions forming disjunctive systems, longitudinal tectonic sutures bounding the principal structural-formation zones of the region. Dislocations with breaks in continuity but belonging to a single system were formed at the same time and under the same geotectonic conditions. Their degree of expression on space photographs in the form of systems of lineaments is determined by the degree of their influence on the formation of present-day morphostructures, that is, by activity in the neotectonic and most recent stages in development of this region. Structures of the central type in most cases constitute a surface reflection of vertical movements of polygonal basement blocks. But there are some structures of the central type whose nature remains unclarified. Space photograph analysis has shown that these materials are of great practical and scientific value for seismic research.

R.J.F.

N86-20244# Joint Publications Research Service, Arlington, Va. **PRINCIPAL PATTERNS OF MORPHOTECTONIC STRUCTURE OF EASTERN CAUCASUS DETECTED BY REMOTE SENSING METHOD Abstract Only**

B. A. BUDAGOV, A. A. MIKAILOV, A. S. ALIYEV, and E. K. ALIZADE *In its* USSR Report: Space (JPRS-USP-86-001) p 142 13 Jan. 1986 Transl. into ENGLISH from Issledovaniye Zemli iz Kosmosa (Moscow, USSR), no. 2, Mar. - Apr. 1985 p 67-72

Avail: NTIS HC A03

On space photographs, the Eastern Caucasus region in general is characterized by a quite nonuniform photoimage pattern attributable to sharp differences in the structure and strike of structural elements and a patchy composition of sedimentary strata. Against this background, interpretation of space photographs has made it possible to define major morphostructural zones, each having its own specific photoimage, pattern and phototone. Particular attention is devoted to the pattern of linear, arcuate and annular lineaments (a map of interpreted lineaments, accompanies the text). The overwhelming majority of lines fit into two conjugate systems of lineaments: orthogonal and diagonal. Lineaments of the orthogonal system with general Caucasian and anti-Caucasus directions show up on the space photographs more clearly and are characterized by a great extent. Longitudinal lineaments, constituting more than 60% of all the interpreted lines, are predominant. Lineaments of an anti-Caucasus strike are more difficult to interpret because they are less clearly expressed in the relief. The diagonal system includes lineaments of northeasterly and northwesterly strikes. The large lineaments for the most part coincide with faults detected by geological-geophysical methods.

Many lineaments are not shown on existing tectonic maps and require field confirmation. Lineaments of each definite strike correspond to definite types of faults. The morphotectonic structure of the Eastern Caucasus as revealed by space photographs is entirely consistent with the theory of plate tectonics.

R.J.F.

N86-20251# Joint Publications Research Service, Arlington, Va. **METHODS FOR STUDYING RECENT TECTONICS USING MATERIALS FROM REMOTE AND SURFACE DATA Abstract Only**

A. A. FREYDLIN, Y. G. FARRAKHOV, and L. F. VOLCHEGURSKIY *In its* USSR Report: Space (JPRS-USP-86-001) p 147-148 13 Jan. 1986 Transl. into ENGLISH from Issledovaniye Zemli iz Kosmosa (Moscow, USSR), no. 1, Jan. - Feb. 1985 p 32-38 Original language document was announced in IAA as A85-29904

Avail: NTIS HC A03

Methods for the complex study of tectonic formations to the east of the near-Caspian depression have been developed on the basis of the interpretation of space (Salyut-4) and aerial photographs in conjunction with other types of geological and geophysical data. This approach led to the determination of: (1) the location and structure of recent tectonic zones; (2) the correlation of interpreted elements relief and deep tectonic characteristics of the region; (3) the connection between oil deposits and tectonic and neotectonic activity; and (4) the role of tectonic processes in the formation of dispersed-sand massifs in the eastern Caspian region.

B.J. (IAA)

N86-20252# Joint Publications Research Service, Arlington, Va. **POSSIBILITIES OF USE OF REMOTE METHODS FOR INCREASING EFFICIENCY OF PETROLEUM AND GAS EXPLORATION WORK Abstract Only**

M. K. ISHANOV, V. A. YUSHIN, A. K. GAYAZOVA, and G. N. MALASHENKOV *In its* USSR Report: Space (JPRS-USP-86-001) p 148-149 13 Jan. 1986 Transl. into ENGLISH from Issledovaniye Zemli iz Kosmosa (Moscow, USSR), n. 1, Jan. - Feb. 1985 p 39-46 Original language document was announced in IAA as A85-29905

Avail: NTIS HC A03

Space photoanomalies corresponding to structures promising for petroleum and gas are usually situated within the limits of anticlinal zones of petroleum and gas accumulation. Many buried anticlines in which petroleum and gas deposits have been discovered stand out as tonal photoanomalies in the near-IR spectral zone where the petroleum deposits show through as ovals of a darker tone, and gas deposits stand out in a lighter tone. Within the limits of the South Tajik Depression, for example, there are a number of discordant lineaments whose strike is not consistent with the most recent folding. Some of the most important features are sublatitudinal lineaments which can be identified with deep ancient faults which exert a great influence on the conditions for the formation and preservation petroleum and gas deposits. The combining of the results of traditional research methods and materials obtained by remote methods made it possible to define a number of promising regions which are recommended for further petroleum and gas exploration work. (These are clearly designated on the tectonic map). These promising regions are described in detail and some space photoanomalies within their limits are analyzed.

R.J.F.

N86-20258# Joint Publications Research Service, Arlington, Va. **DISCRIMINATING HOMOGENEOUS REGIONS WITH INCOMPLETE BOUNDARIES ON IMAGE Abstract Only**

A. A. ZLATOPOLSKIY *In its* USSR Report: Space (JPRS-USP-86-001) p 153-154 13 Jan. 1986 Transl. into ENGLISH from Issledovaniye Zemli iz Kosmosa (Moscow, USSR), no. 1, Jan. - Feb. 1985 p 94-102 Original language document was announced in IAA as A5-29912

Avail: NTIS HC A03

An image segmentation method according to identified parts of region boundaries is proposed in the framework of the

interpretation of remote-sensing images. Results of a theoretical analysis of a structure generated by a distance transformation are presented, and an algorithm based on the structure is formulated. An example of the application of the algorithm to geological image analysis is examined. B.J. (IAA)

N86-20449# Joint Publications Research Service, Arlington, Va.
NEW METHOD FOR GEOLOGICAL INTERPRETATION OF ANNULAR STRUCTURES WITHIN COVERED AND PARTIALLY COVERED AREAS Abstract Only

B. S. ZEYLIK, L. G. PERFIYEV, A. N. VASILENKO, and E. Y. SEYTMURATOVA *In its* USSR Report: Space (JPRS-USP-86-002) p 66 10 Feb. 1986 Transl. into ENGLISH from Issledovaniye Zemli Iz Kosmosa (Moscow, USSR), no. 4, Jul. - Aug. 1985 p 31-40 Original language document was announced in IAA as A86-13279
 Avail: NTIS HC A05

Digital modelling of topographic features in low angle sunlight is proposed to identify ring structures in remote sensing images. The technique was used to construct a relief image of the Shunak crater based on satellite measurements of solar irradiance in four directions. A map of the Shunak crater, showing the isolines of the total solar irradiance is provided. I.H.

N86-21004# Geological Survey, Denver, Colo.
INVESTIGATION OF AN AEROMAGNETIC ANOMALY ON WEST SIDE OF YUCCA MOUNTAIN, NEY COUNTY, NEVADA

G. D. BATH and C. E. JAHREN 1985 29 p refs
 (Contract DE-A108-78ET-44802)
 (DE85-018329; USGS-OF-85-459) Avail: NTIS HC A03/MF A01

Investigations of the source of a prominent aeromagnetic anomaly of 290 nT were undertaken at a potential repository site located in the Yucca Mountain area, Nevada Test Site. The anomaly was detected on a recent flight line of a survey flown north-south at 400 m (1300 ft) spacing and 122 m (400 ft) above the surface. The anomaly, which is on the high-standing side of a major fault, was interpreted previously as arising from either an increase of magnetization within a volcanic tuff or a small intrusive feature. Both air and ground anomalies were analyzed using geologic data from surface mapping and drill holes, and magnetic property data from drill holes. The anomaly is caused by contributions from at least three sources. The elevated topography gives a terrain effect since the altitude is decreased between the airplane and exposed Topopah Spring Member of the Paintbrush Tuff. Ground anomalies 300 m (1000 ft) south of the air maximum indicate either an increase in magnetization or the presence of a small intrusive body. Finally, there is an increase in magnetic influence from the nearby Solitario Canyon fault. DOE

N86-21970*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.

PERFORMANCE EVALUATION AND GEOLOGIC UTILITY OF LANDSAT-4 THEMATIC MAPPER DATA

E. D. PAYLOR, M. J. ABRAMS, J. E. CONEL, A. B. KAHLE, and H. R. LANG 15 Oct. 1985 77 p refs
 (Contract NAS7-918)

(NASA-CR-176660; JPL-PUB-85-66; NAS 1.26:176660) Avail: NTIS HC A05/MF A01 CSCL 08B

The overall objective of the project was to evaluate LANDSAT-4 Thematic Mapper (TM) data in the context of geologic applications. This involved a quantitative assessment of the data quality including the spatial and spectral characteristics realized by the instrument. Three test sites were selected for the study: (1) Silver Bell, Arizona; (2) Death Valley, California; and (3) Wind River/Bighorn Basin area, Wyoming. Conclusions include: (1) Artificial and natural targets can be used to atmospherically calibrate TM data and investigate scanner radiometry, atmospheric parameters, and construction of atmospheric Modulation Transfer Functions (MTF's), (2) No significant radiometric degradation occurs in TM data as a result of SCROUNGE processing; however, the data exhibit narrow digital number (DN) distributions suggesting that the configuration of the instrument is not optimal for each science applications, (30

Increased spatial resolution, 1:24,000 enlargement capability, and good geometric fidelity of TM data allow accurate photogeologic/geomorphic mapping, including relative age dating of alluvial fans, measurement of structural and bedding attitudes, and construction of such things as structural cross sections and stratigraphic columns. (4) TM bands 5 and 7 are particularly useful for geologic applications because they span a region of the spectrum not previously sampled by multispectral scanner data and are important for characterizing clay and carbonate materials.

Author

N86-21971# Geological Survey, Flagstaff, Ariz.

DESERT STUDIES: A GLOBAL VIEW Final Report, 5 Apr. 1982 - 30 Jun. 1985

J. F. MCCAULEY, C. S. BREED, and M. J. GROLIER 23 Aug. 1985 24 p

(Contract MIPR-155-84)

(AD-A161453; ARO-18405.12-GS) Avail: NTIS HC A02/MF A01 CSCL 08F

Results of work on summary reports of the surficial geology and geomorphology of Coastal Peru, Western Desert of Egypt/Sudan, and deserts of China (including the Taklimakan, Badan Jarain, and Hohsi Corridor) are outlined. Sections of summary reports on these hyperarid regions have been published as journal articles, interim technical reports, and abstracts. Significant new findings have been described in interim published reports on the Western Desert. These include the discovery of a buried paleofluvial terrain, over printed by aeolian erosion and deposition, which controls the topography and trafficability of much of southwest Egypt and northwest Sudan. A new model for the Western Desert relates a series of superposed river networks, concealed beneath a centimeters-to-meters thick veneer of wind blown sand sheets and dunes to the composition and distribution of surficial and subjacent geologic units, including soil parent materials. A key finding has been the role of groundwater carbonate deposition in recording the sequence of Quaternary fluvial episodes and climatic fluctuations in this region, as well as the present-day influence of the caliche deposits on radar responses of interfluvial, valley fill, and inset channel units. Preliminary results of field reconnaissance, LANDSAT, and Shuttle Imaging Radar (SIR-A and SIR-B) studies of deserts in Northwest China show evidence there, too, of radar signal penetration through dry sand to underlying bedrock and alluvium. GRA

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OCEANOGRAPHY AND MARINE RESOURCES

Includes sea-surface temperature, ocean bottom surveying imagery, drift rates, sea ice and icebergs, sea state, fish location.

A86-19481

REMOTE SENSING OF COASTAL AND OCEAN PROPERTIES

V. KLEMAS (Delaware, University, Newark) IN: Remote sensing; Proceedings of the Meeting, Arlington, VA, May 1, 2, 1984. Bellingham, WA, SPIE - The International Society for Optical Engineering, 1984, p. 42-54. refs

It is pointed out that remote sensing has become quite important for the monitoring of marine resources and for coastal research. The present paper has the objective to summarize the state of the art of the remote sensing of coastal and ocean properties and to indicate new sensing techniques needed for meeting user requirements. Coastal studies which can benefit from remote sensing are related to the mapping of coastal vegetation and its biomass, the monitoring of man-made and natural changes in the coastal zone, hydrographic charting, the mapping of geomorphic features, the detection of coastal fresh-water springs, the mapping of chlorophyll and nutrient-rich upwelling regions important to fisheries resources management, and the charting of current circulation. G.R.

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A86-19506* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
GODDARD LABORATORY FOR ATMOSPHERIC SCIENCES PHYSICAL RETRIEVAL SYSTEM FOR REMOTE DETERMINATION OF WEATHER AND CLIMATE PARAMETER FROM HIRS2 AND MSU OBSERVATIONS

J. SUSSKIND (NASA Goddard Space Flight Center, Greenbelt, MD) IN: Recent advances in civil space remote sensing; Proceedings of the Meeting, Arlington, VA, May 3, 4, 1984. Bellingham, WA, SPIE - The International Society for Optical Engineering, 1984, p. 122-128. refs

At the Goddard Laboratory for Atmospheric Sciences (GLAS) a physically based satellite temperature sounding retrieval system, involving the simultaneous analysis of HIRS2 and MSU sounding data, was developed for determining atmospheric and surface conditions which are consistent with the observed radiances. In addition to determining accurate atmospheric temperature profiles even in the presence of cloud contamination, the system provides global estimates of day and night sea or land surface temperatures, snow and ice cover, and parameters related to cloud cover. Details of the system are described elsewhere. A brief overview of the system is presented, as well as recent improvements and previously unpublished results, relating to the sea-surface intercomparison workshop, the diurnal variation of ground temperatures, and forecast impact tests. Author

A86-19508
REQUIREMENTS FOR SPACE-SENSED OCEANOGRAPHIC DATA

D. C. HONHART (U.S. Navy, Washington, DC) IN: Recent advances in civil space remote sensing; Proceedings of the Meeting, Arlington, VA, May 3, 4, 1984. Bellingham, WA, SPIE - The International Society for Optical Engineering, 1984, p. 142-148.

Requirements and the desirability of the Navy Remote Ocean Sensing System (NROSS) from the Navy's viewpoint are examined. The benefits that were shown by the short-lived Seasat satellite would be greatly exceeded by the proposed NROSS. The proposal is to fly the NROSS oceanographic satellite as part of the Defense Meteorological Satellite Program constellation. The Navy's intention is to make the processed ocean data available to the civil and scientific communities through existing NOAA communications circuits. To provide equivalent needed coverage of the ocean environment by conventional means (ships, buoy, etc.), would be twice as costly as the proposed 290 million dollar NROSS oceanographic satellite in the first three years of operation. D.H.

A86-19509
CIVIL OCEANIC REMOTE SENSING NEEDS

J. W. SHERMAN, III (NOAA, Oceanic Sciences Branch, Washington, DC) IN: Recent advances in civil space remote sensing; Proceedings of the Meeting, Arlington, VA, May 3, 4, 1984. Bellingham, WA, SPIE - The International Society for Optical Engineering, 1984, p. 149-158. refs

The analysis of the requirements for satellite-derived oceanic data to meet the needs of the civil marine community has been a continuing effort by the National Oceanic and Atmospheric Administration (NOAA). The priorities established for the most critical data are, in decreasing order: winds, sea surface temperature, waves, sea ice, ocean color, and circulation and currents. The general needs of academic, commercial, and governmental users are considered, with more detailed requirements for wave data presented as an example. The consideration of these needs are presented within the context of planned satellites that have been designed to meet national and international scientific and operational requirements. Author

A86-19510* Jet Propulsion Lab., California Inst. of Tech., Pasadena.

SPACEBORNE STUDIES OF OCEAN CIRCULATION

W. C. PATZERT (California Institute of Technology, Jet Propulsion Laboratory, Pasadena) IN: Recent advances in civil space remote sensing; Proceedings of the Meeting, Arlington, VA, May 3, 4, 1984. Bellingham, WA, SPIE - The International Society for Optical Engineering, 1984, p. 159-164. NASA-supported research.

The history and near-term future of ocean remote sensing to study ocean circulation are examined. Seasat provided the first-ever global data sets of sea surface topography (altimeter) and marine winds (scatterometer) and laid the foundation for the next generation of satellite missions planned for the late 1980s. The future missions are the next generation of altimeter and scatterometer to be flown aboard TOPEX (TOPOgraphy EXperiment) and NROSS (Navy Remote Sensing System), respectively. The data from these satellites will be coordinated with measurements made at sea to determine the driving forces of ocean circulation and to study the oceans' role in climate variability. The significance of such studies to such matters as climatic changes, fisheries, commerce, waste disposal, and national defense is noted. D.H.

A86-19511* Jet Propulsion Lab., California Inst. of Tech., Pasadena.

OBSERVING THE POLAR REGIONS FROM SPACE

R. H. THOMAS (California Institute of Technology, Jet Propulsion Laboratory, Pasadena) IN: Recent advances in civil space remote sensing; Proceedings of the Meeting, Arlington, VA, May 3, 4, 1984. Bellingham, WA, SPIE - The International Society for Optical Engineering, 1984, p. 165-171. NASA-supported research. refs

The use of active and passive microwave sensors to provide information on the ice cover in the earth's polar regions is described, along with the ice characteristics that can be measured by such techniques. The continental ice sheets of Greenland and Antarctica represent vast reservoirs of fresh water that can significantly impact sea level if the ice sheets are changing in size. Satellite remote sensing gives information on: sea ice extent and physical characteristics; detailed images of ice flows and open-water leads within the ice pack; sea-ice movement; zones of summer melting and snow-accumulation rates on the continental ice sheets; accurate estimates of ice-surface elevation and detection of zones on the ice sheet that are either thickening or thinning; accurate, all-weather mapping of ice coastlines and large crevasses, and estimates of ice discharge rates from the ice sheets. D.H.

A86-19512
ALTIMETER FOR THE OCEAN TOPOGRAPHY EXPERIMENT (TOPEX)

J. L. MACARTHUR and P. V. K. BROWN (Johns Hopkins University, Laurel, MD) IN: Recent advances in civil space remote sensing; Proceedings of the Meeting, Arlington, VA, May 3, 4, 1984. Bellingham, WA, SPIE - The International Society for Optical Engineering, 1984, p. 172-180. refs

The evolution of satellite altimetry from Skylab-1, GEOS-3, and Seasat-1 to the current U.S. Navy Program, Geosat-A, has been accompanied by a continuing improvement in measurement precision along with a better understanding of those factors internal and external to the instrument that act to limit precision. The precision goal of 2 centimeters imposed by the TOPEX mission will be realized by incremental enhancements to existing designs whose effectiveness has been demonstrated. The TOPEX altimeter will use a high pulse-rate, burst waveform and dual frequency (13.6/5.3 GHz) operation to minimize height measurement noise and remove ionospheric bias. Author

A86-19514* Jet Propulsion Lab., California Inst. of Tech., Pasadena.

NROSS SCATTEROMETER - AN INSTRUMENT FOR GLOBAL OCEANIC WIND OBSERVATIONS

F. LI, C. WINN, D. LONG, and C. GEUY (California Institute of Technology, Jet Propulsion Laboratory, Pasadena) IN: Recent advances in civil space remote sensing; Proceedings of the Meeting, Arlington, VA, May 3, 4, 1984. Bellingham, WA, SPIE - The International Society for Optical Engineering, 1984, p. 193-198. NASA-supported research. refs

One of the instruments - the NROSS scatterometer or SCATT - to be launched on the Navy Remote Ocean Sensing System spacecraft in 1989 is discussed. To determine wind speed and direction that SCATT will measure the ocean normalized radar cross section (NRCS) by illuminating the ocean's surface with microwave pulses and measuring the return signal power. A wind retrieval algorithm is used to compute the wind speed and direction from the measured NRCS. Winds over at least 90 percent of the global, ice-free ocean will be observed at least once every two days. For NASA users, the system will retrieve winds with an accuracy of plus or minus 2 m/s or 10 percent whichever is greater, for wind speeds ranging from 3 to 30 m/s. D.H.

A86-19515

LOW FREQUENCY MICROWAVE RADIOMETER FOR N-ROSS

J. P. HOLLINGER and R. C. LO (U.S. Navy, Naval Research Laboratory, Washington, DC) IN: Recent advances in civil space remote sensing; Proceedings of the Meeting, Arlington, VA, May 3, 4, 1984. Bellingham, WA, SPIE - the International Society for Optical Engineering, 1984, p. 199-207. Previously announced in STAR as N85-23819. refs

The all weather, global determination of sea surface temperature (SST) has been identified as a requirement needed to support naval operations. The target SST accuracy is \pm or 1.0 K with a surface resolution of 10 km. Investigations of the phenomenology and technology of remote passive microwave sensing of the ocean environment over the past decade have demonstrated that this objective is presently attainable. Preliminary specification and trade off studies were conducted to define the frequency, polarization, scan geometry, antenna size, and other essential parameters of the low frequency microwave radiometer (LFMR). It will be a meter deployable mesh surface antenna. It is to be flown on the Navy-Remote Ocean Sensing System (N-ROSS) satellite scheduled to be launched in late 1988. M.G.

A86-19516

PRACTICAL APPLICATIONS OF NIMBUS-7 COASTAL ZONE COLOR SCANNER DATA

W. A. HOVIS (NOAA, National Environmental Satellite, Data, and Information Service, Washington, DC) IN: Recent advances in civil space remote sensing; Proceedings of the Meeting, Arlington, VA, May 3, 4, 1984. Bellingham, WA, SPIE - The International Society for Optical Engineering, 1984, p. 208-211.

An account is given of how the Coastal Zone Color Scanner (CZCS), launched on the Nimbus-7 spacecraft in October of 1978, is being used as a quasi-operational instrument even though it was designed strictly for research and had only a one-year expected lifetime. It has been used to guide scientific vessels to areas of particular interest and to guide fisherman to areas of optimum probability for catching fish. On-orbit recalibration of the instrument has been accomplished to compensate for long-term degradation. The lessons learned provide valuable insight into how a future operational CZCS should be built. D.H.

A86-19517

FUTURE SYSTEMS FOR SPACEBORNE OCEANOGRAPHY

C. T. SWIFT, R. E. MCINTOSH, R. S. RAGHAVAN, C. A. WILEY, and L. E. SOMERS (Massachusetts, University, Amherst) IN: Recent advances in civil space remote sensing; Proceedings of the Meeting, Arlington, VA, May 3, 4, 1984. Bellingham, WA, SPIE - The International Society for Optical Engineering, 1984, p. 212-220. refs

As a proof of concept, the Seasat oceanographic satellite successfully demonstrated the role of microwave sensors to synoptically measure geophysical parameters of interest to the oceanographic and meteorological communities. Nevertheless, problems surfaced, which can be corrected by improved system design concepts. Indeed, the next generation of satellite systems will incorporate modest engineering improvement which will greatly ease data reduction problems. Of more importance, however, the Seasat activity has generated ideas for new classes of measurements for the future. This paper explores a possible long term system growth in microwave scatterometry and radiometry.

Author

A86-20101

REMOTE SENSING FOR OCEANOGRAPHY - AN OVERVIEW

L. F. MCGOLDRICK (Johns Hopkins University, Lawrence, MD) Johns Hopkins APL Technical Digest (ISSN 0270-5214), vol. 6, Oct.-Dec. 1985, p. 284-292. refs

A development history of satellite-based oceanographic studies is presented, with a view to technological trends and prospective developments for the remaining years of this century. Attention is given to the progressively deeper investigation of wind stresses driving oceanic currents by means of Ku-band radars, pencil beam radiometer/scatterometer, and SAR, as well as of mesoscale variability, and the contributions of radar altimetry to sea level studies and of data collection and location systems to the Global Weather Experiment. Global marine wind, sea surface topography, and phytoplanktonic and temperature patterns' correlation study results are used to illustrate noteworthy successes for satellite-borne oceanography. O.C.

A86-20106

HYDRODYNAMICS AND RADAR SIGNATURES OF INTERNAL SOLITONS IN THE ANDAMAN SEA

J. R. APEL, D. R. THOMPSON, D. G. TILLEY (Johns Hopkins University, Laurel, MD), and P. VAN DYKE (T. Rowe Price Associates, Baltimore, MD) Johns Hopkins APL Technical Digest (ISSN 0270-5214), vol. 6, Oct.-Dec. 1985, p. 330-337. refs

Attention is given to the hydrodynamic properties of the internal soliton wave phenomena reported to occur with exceptional frequency in the Andaman Sea region of the Indian Ocean, in light of Shuttle Imaging Radar data. The current theory for internal solitary waves and radar backscatter modulations from them yields reasonable estimates for both the hydrodynamics and electromagnetics of the phenomena, at least for the case of low wind speeds and 30-cm radar wavelength. The cnoidal wave packet model, when used in conjunction with the imagery in question and historical density profiles, yields wave property values that are well within \pm or - 50 percent of the actual ones. O.C.

A86-20109

MEASUREMENTS OF DIRECTIONAL WAVE SPECTRA BY THE SHUTTLE SYNTHETIC APERTURE RADAR

F. M. MONALDO (Johns Hopkins University, Laurel, MD) Johns Hopkins APL Technical Digest (ISSN 0270-5214), vol. 6, Oct.-Dec. 1985, p. 354-360. refs

Directional ocean wave spectra were made in high sea states near Tierra del Fuego during October 1984, using the Shuttle Imaging Radar-B (SIR-B) SAR instrument; independent simultaneous measurements of ocean wave spectra were made by a complement of airborne instruments. A comparison of the SIR-B experiment results with the radar ocean wave spectrometer data obtained suggests that the SAR image intensity variance spectrum for range-traveling waves is most closely associated with the ocean slope variance spectrum. The azimuth resolution

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limitations induced by ocean surface motion, which are inherent in Seasat imagery, are substantially reduced by a low altitude SAR. O.C.

A86-20671* Jet Propulsion Lab., California Inst. of Tech., Pasadena.

THE NASA/JPL PILOT OCEAN DATA SYSTEM CATALOG

J. A. JOHNSON (California Institute of Technology, Jet Propulsion Laboratory, Pasadena) IN: Spatial information technologies for remote sensing today and tomorrow; Proceedings of the Ninth Pecora Symposium, Sioux Falls, SD, October 2-4, 1984. Silver Spring, MD, Institute of Electrical and Electronics Engineers, Inc., 1984, p. 148-152. NASA-supported research.

Data from various ground and satellite sensors collected and processed by various institutions cannot be used easily without a well planned method of determining their existence and location. The Global On-Line Data (GOLD) Catalog will provide a requestor with the ability to determine the existence of specific data holdings by specifying any combination of platform, measurement, location, or time. By this means, one can obtain details of data held at PODS and also at cooperating remote archives. Author

A86-21112#

THE APPLICATION AND POTENTIAL OF REMOTE SENSING TO PLANNING AND MANAGING THE GREAT BARRIER REEF OF AUSTRALIA

D. L. B. JUPP, K. K. MAYO (CSIRO, Div. of Water and Land Resources, Canberra, Australia), D. A. KUCHLER (North Queensland, University, Townsville, Australia), D. VAN R. CLAASEN, R. A. KENCHINGTON (Great Barrier Reef Marine Park Authority, Townsville, Australia) et al. IN: International Symposium on Remote Sensing of Environment, 18th, Paris, France, October 1-5, 1984, Proceedings. Volume 1. Ann Arbor, MI, Environmental Research Institute of Michigan, 1985, p. 121-137. refs

The CSIRO Division of Water and Land Resources has cooperated with the Great Barrier Reef Marine Park Authority (GBRMPA) and the Australian Survey Office (ASO) to establish comprehensive remote sensing based reef mapping procedures. The research established the benefits of remotely sensed data to planning and managing the GBR Marine Park as well as methods of analysis specific to the problems of reef top mapping. The ASO is applying a mapping program based on this research to the whole of the GBR and will complete the task (involving some 24 Landsat scenes) by December 1984. The products consist of rectified Landsat imagery at 1:250,000 and 1:100,000 scales and standard thematic products which indicate approximate bathymetry, reef geomorphological and cover zones and reef environmental parameters such as exposure to weather. Author

A86-21114#

GEOSAT AND N-ROSS

J. W. SHERMAN, III (NOAA, National Environmental Satellite, Data, and Information Service, Washington, DC) IN: International Symposium on Remote Sensing of Environment, 18th, Paris, France, October 1-5, 1984, Proceedings. Volume 1. Ann Arbor, MI, Environmental Research Institute of Michigan, 1985, p. 159-166.

The United States through the efforts of the Department of Defense will launch two satellites of significance to all marine users. In February, 1985, Geosat is to be launched to conclude the geodetic mission begun by Seasat. In mid-1989 a major thrust forward in applying satellite-derived oceanic data to operational marine needs will be made by the Navy Remote Ocean Sensing System. This paper emphasizes the technical characteristics of these two satellites and the expected oceanic products, with the focus on winds and waves and their all-weather monitoring capabilities. Author

A86-21116*# National Aeronautics and Space Administration, Washington, D.C.

TOPEX/POSEIDON - A PROPOSED JOINT NASA/CNES ALTIMETRY MISSION

W. S. WILSON (NASA, Washington, DC) and J.-L. FELLOUS (CNES, Paris, France) IN: International Symposium on Remote Sensing of Environment, 18th, Paris, France, October 1-5, 1984, Proceedings. Volume 1. Ann Arbor, MI, Environmental Research Institute of Michigan, 1985, p. 187-190. refs

A dedicated altimetry mission has been proposed to be conducted jointly by the U.S. National Aeronautics and Space Administration (NASA) and the French Centre National d'Etudes Spatiales (CNES). The mission goal would be focused on advancing the understanding of the general circulation of the global oceans. The mission would involve a U.S. satellite carrying U.S. and French sensors and launched by a French Ariane launch vehicle. Launch would occur in 1990, and the mission would be planned as an integral part of oceanographic programs being proposed under the auspices of the World Climate Research Program. Author

A86-21149#

REMOTE SENSING THE NEARSHORE VEGETATION OF QUEBEC COASTS

E. LAMBERT, A. LAVOIE, J.-M. M. DUBOIS, D. CLAVET (Sherbrooke, Université, Canada), L. GENDRON (Quebec, Ministère de l'Agriculture, des Pêcheries et de l'Alimentation, Gaspé, Canada) et al. IN: International Symposium on Remote Sensing of Environment, 18th, Paris, France, October 1-5, 1984, Proceedings. Volume 1. Ann Arbor, MI, Environmental Research Institute of Michigan, 1985, p. 535-541. Research supported by the Ministère de l'Agriculture, des Pêcheries et de l'Alimentation du Québec. refs

Remote sensing of nearshore vegetation in a marine environment is limited by light penetration and water depth. This constraint is more or less present depending on the water quality and the water depth at which the vegetation stands. A method was developed for sensing submerged vegetation by using airborne images for digital analysis. Results from the digital data analysis are highly similar to the ground truthed data. Therefore the digital analysis of airborne images offers an accurate technique for remote sensing submerged vegetation. Author

A86-21157#

COMPARISON BETWEEN THERMAL AND VISIBLE SATELLITE IMAGERY TO ASSESS COASTAL UPWELLINGS IN THE MEDITERRANEAN

D. CARAUX, C. MILLOT (Laboratoire Arago, Banyuls, France), and G. JACQUES (Muséum National d'Histoire Naturelle, La Seyne-sur-Mer, France) IN: International Symposium on Remote Sensing of Environment, 18th, Paris, France, October 1-5, 1984, Proceedings. Volume 1. Ann Arbor, MI, Environmental Research Institute of Michigan, 1985, p. 621-628. CNRS-Navy-supported research. refs

A comparative study of satellite imagery delineating thermal boundaries or bio-optical fronts in the Gulf of Lions is reported. Infrared and visible data were compared after image processing analysis. These sensors are borne by satellite placed on sun-synchronized orbits. Their orbit characteristics allow an almost simultaneous visualization of oceanic features (sea surface temperature, suspended matter in the first layers of the ocean). Before deriving these parameters from satellite data, raw data were calibrated and atmospheric correction was implemented. In order to compare data from various sensors aboard various satellites, distorted images were corrected for geometry. A set of visible and infrared satellite images was processed and compared so as to specify the biological environment associated with coastal upwellings in the Mediterranean. The purpose of the present study was to establish correlations between the observed surge of suspended matter (visible signal) and upwelling of colder deep water (infrared signal). The study points out the complementary usefulness of sensing simultaneously the different bands of the light spectrum to obtain physical and biological information regarding coastal dynamics. Author

A86-21158#

EVALUATION OF LANDSAT THEMATIC MAPPER DATA FOR SHALLOW WATER BATHYMETRY

F. J. TANIS (Environmental Research Institute of Michigan, Ann Arbor) and W. A. HALLADA (Science Applications Research, Riverdale, MD) IN: International Symposium on Remote Sensing of Environment, 18th, Paris, France, October 1-5, 1984, Proceedings. Volume 2. Ann Arbor, MI, Environmental Research Institute of Michigan, 1985, p. 629-643. DMA-supported research. refs

(Contract N00014-83-C-2234)

In response to the increased demand for updated accurate charts of the world's oceans, the Defense Mapping Agency (DMA) and other global hydrographic survey and charting organizations have begun the development of a remote bathymetry capability. Essentially the possibility of an implementation of the considered passive remote sensing technique depends upon finding a relationship between the measured water depth and the reflected radiance in one or more wavelength bands. The remote bathymetry effort had the objective to develop a satellite and airborne capability involving either lidar or an active/passive scanner system. The latter is preferred for airborne applications because of the greater spatial sampling. The feasibility of a use of the Landsat 4 imaging instruments MSS and TM was investigated. In the present paper, the quality and information content of TM are compared with MSS. The capabilities of simple regression type algorithms to extract water depth information are also explored. G.R.

A86-21166#

ATMOSPHERIC EFFECTS IN MULTIPLE-LOOK OBSERVATIONS FROM SPACE

G. KHOSRAVIANI and A. P. CRACKNELL (Dundee, University, Scotland) IN: International Symposium on Remote Sensing of Environment, 18th, Paris, France, October 1-5, 1984, Proceedings. Volume 2. Ann Arbor, MI, Environmental Research Institute of Michigan, 1985, p. 751-757. refs

In this paper attention is given to the results of some calculations based on the use of Coastal Zone Color Scanner (CZCS) data for the Irish Sea viewed from two successive orbits of the Nimbus-7 satellite. The atmospheric components have been extracted from successive orbits and compared. There are two motives for this. First, this provides a novel method of evaluating results obtained from CZCS data which have, traditionally, only been evaluated by attempting to make in-situ measurements of chlorophyll concentration. Secondly, the approaching launch of the first of the SPOT series of satellites opens up the possibility of obtaining stereoscopic images from space and it is believed to be important to try to evaluate the significance of atmospheric effects on the quality of such images. Author

A86-21178*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

RADIOMETRIC COMPARISON OF TWO OCEAN COLOR SCANNERS NIMBUS-7/CZCS AND OSTA-1/OCE

H. H. KIM (NASA, Goddard Space Flight Center, Greenbelt, MD; DFVLR, Institut fuer Optoelektronik, Oberpfaffenhofen, West Germany), H. VAN DER PIEPEN, M. VIOLLIER, R. FIEDLER, J. S. VAN DER PIEPEN (DFVLR, Institut fuer Optoelektronik, Oberpfaffenhofen, West Germany) et al. IN: International Symposium on Remote Sensing of Environment, 18th, Paris, France, October 1-5, 1984, Proceedings. Volume 2. Ann Arbor, MI, Environmental Research Institute of Michigan, 1985, p. 931-937. refs

On November 14, 1981 the area around the Gibraltar Strait was observed by two different ocean color scanners: a Space Shuttle-borne Ocean Color Experiment and Coastal Zone Color Scanner (Nimbus-7/CZCS). This presented an opportunity to study the gradual degradation of the CZCS sensitivity by comparing the two sensors. Upwelling radiances from eleven targets were compared. The results of the analysis indicate that the CZCS sensitivities at channels 1 and 2 are down to 65 percent and 78 percent. However, the evidence for channels 3 and 4 deterioration could not be found. Author

A86-21196#

THE IDENTIFICATION OF THE SURFACE EXPRESSIONS OF BATHYMETRIC FEATURES FROM SAR OCEAN IMAGES

R. L. G. SCHUMANN, M. A. FIDDY (King's College, London, England), and L. W. THORPE (Scicon, Ltd., London, England) IN: International Symposium on Remote Sensing of Environment, 18th, Paris, France, October 1-5, 1984, Proceedings. Volume 2. Ann Arbor, MI, Environmental Research Institute of Michigan, 1985, p. 1153-1160. SERC-supported research.

It is well known that microwave images obtained by side-looking SAR imagers such as Seasat reveal much structure in the oceans. The problems associated with making a quantitative assessment of the relation between images taken over the ocean by Seasat and images derived from known bathymetric information taken from Admiralty charts are described. While it is often fairly straightforward to judge by eye the correlation between map depth contours and the corresponding SAR image, considerable preprocessing of the available data is required in order to most effectively determine the degree of correlation. Examples are given and the relevance of this work to the Shuttle Imaging experiment (SIR-B) is discussed. Author

A86-21197#

THEMATIC STUDY OF 1982 SPOT SIMULATION OF ROSCOFF AND THE WEST COAST OF THE COTENTIN PENINSULA (FRANCE)

T. BELSHER (Centre National pour l'Exploitation des Oceans, Roscoff, France) and M. VIOLLIER (CNRS, Roscoff, France) IN: International Symposium on Remote Sensing of Environment, 18th, Paris, France, October 1-5, 1984, Proceedings. Volume 2. Ann Arbor, MI, Environmental Research Institute of Michigan, 1985, p. 1161-1166.

Partial analysis of SPOT simulated imagery for the remote sensing of intertidal seaweeds are presented. Attempts are made to give quantitative evaluation of the vegetation cover percentage and to appreciate the reliability of the species differentiation obtained from statistical analysis. Author

A86-21210#

A METHOD TO INTEGRATE NOAA/AVHRR INFRARED IMAGE WITH CHLOROPHYLL CONCENTRATION MAP GENERATED BY CZCS DATA AND ITS APPLICATION TO THE SEA OF OKHOTSK

M. SATO, Y. TOZAWA, M. IOKA (IBM Japan, Ltd., Japan Science Institute, Tokyo), K. MUNAYAMA, Y. SASAKI (Japan Marine Science and Technology Center, Yokosuka) et al. IN: International Symposium on Remote Sensing of Environment, 18th, Paris, France, October 1-5, 1984, Proceedings. Volume 3. Ann Arbor, MI, Environmental Research Institute of Michigan, 1985, p. 1343-1352. refs

A method to superimpose a sea-surface temperature map on a chlorophyll concentration map is presented. These maps are provided through the observation by NOAA and Nimbus-7 satellites. A sea-surface temperature map is first transformed into an isothermal lines map after the lands and the areas covered with ice and clouds are detected and labelled. This isothermal lines map is then superimposed on a chlorophyll concentration map. With the CZCS data, geometric correction, which is usually a process required to superimpose the images, is carried out without using the anchor point data. This is advantageous to users because the anchor point data are often missing in the data records. Orbital information is estimated by considering such information as satellite motion and two ground control points. This information is necessary when geometric distortion is corrected into a Mercator projection. As an example, a scene of the Sea of Okhotsk is processed and the results are discussed. Author

05 OCEANOGRAPHY AND MARINE RESOURCES

A86-21219#

STUDY OF MARINE AND INTERTIDAL ZONES OF THE BAY OF MONT SAINT MICHEL ON THE BASIS OF SPOT SIMULATION [ETUDE DES ZONES MARINE ET INTERTIDALE DE LA BAIE DU MONT SAINT MICHEL A PARTIR D'UNE SIMULATION SPOT]

R. M. ZBINDEN (Ecole Normale Supérieure, Montrouge, France) IN: International Symposium on Remote Sensing of Environment, 18th, Paris, France, October 1-5, 1984, Proceedings. Volume 3. Ann Arbor, MI, Environmental Research Institute of Michigan, 1985, p. 1443-1451. In French. refs

Daedalus radiometer data on the Bay of Mont Saint Michel acquired on September 17, 1982 were used for SPOT simulations. An interpretation of the marine zone and of the strand on the basis of the simulations is proposed. Simulation data are validated using sea measurements of turbidity and strand measurements of sediment reflectance. B.J.

A86-21234#

UNITED STATES COAST GUARD ACQUISITION OF REMOTE SENSING CAPABILITY FOR OCEAN SURVEILLANCE

J. R. WHITE (USCG, Washington, DC) IN: International Symposium on Remote Sensing of Environment, 18th, Paris, France, October 1-5, 1984, Proceedings. Volume 3. Ann Arbor, MI, Environmental Research Institute of Michigan, 1985, p. 1605-1615.

An account is given of the U.S. Coast Guard development of an airborne, real-time, all-weather, day/night remote sensing system that will detect oil slicks at sea and identify violating vessels. The system has been designated 'Aireye' and will be installed on six of the 41 new Falcon 20 G jet aircraft (military designation HU-25A) which the Coast Guard has recently purchased as its medium range surveillance aircraft. The sensor system will include a side-looking airborne radar, three channel IR/UV line scanner, aerial reconnaissance camera, airborne data annotation system, and a control-display-record console. An active gated television camera will be used to identify vessels at night. D.H.

A86-21235#

APPLICATION OF A FORWARD LOOKING THERMAL SCANNER FOR DETECTING AND MONITORING OIL SPILLS

H. T. RIPLEY (Atlantic Canada Airborne Sensing Inc., Amherst) and R. H. GOODMAN (Esso Resources Canada, Ltd., Calgary) IN: International Symposium on Remote Sensing of Environment, 18th, Paris, France, October 1-5, 1984, Proceedings. Volume 3. Ann Arbor, MI, Environmental Research Institute of Michigan, 1985, p. 1617-1627. Research supported by the Canadian Offshore Aerial Applications Task Force. refs

An oil spill dispersant sea trial was held offshore Halifax, Nova Scotia, Canada (44 deg 30 m N, 63 deg 00 m W) during the period September 12-17, 1983. Remote sensing played an integral part of the experiment. A specialized aircraft, instrumented for remote sensing research was used for airborne data collection. Part of the sensor package included a forward looking thermal infrared scanner. This was the first time this type of scanner was mounted on a fixed wing aircraft in Canada and the first test of its ability to detect and monitor marine oil spills. The program, including the thermal scanner operation, was quite successful. The data collected during the trials was instrumental in the determination of the overall experiment effectiveness. Author

A86-21239#

VISIBLE AND INFRARED SEA ICE MAPPING FROM SATELLITES

B. WANNAMAKER, A. CONDAL, and H. LE (Department of the Environment, Atmospheric Environment Service, Downsview, Canada) IN: International Symposium on Remote Sensing of Environment, 18th, Paris, France, October 1-5, 1984, Proceedings. Volume 3. Ann Arbor, MI, Environmental Research Institute of Michigan, 1985, p. 1671-1675. refs

The type and extent of ice covering the world's ocean has important economic and climatic effects. High latitude resource development, biological productivity and air-sea interaction are all inhibited by ice. Satellite visible and infrared data have aided sea

ice monitoring for twenty years but improving knowledge of the parameters of ice is changing the way the data is used. Considering data from the Advanced Very High Resolution Radiometer, an 'ice channel' is created from a combination of the visible and near infrared data. The 12 micron channel or a 'sea surface temperature' channel is generally better at detecting ice than the 10.5 micron channel. The artificial channels are used in an example of multispectral classification of ice in the Gulf of St. Lawrence.

Author

A86-21243#

MOTIONS AND CONCENTRATIONS OF SUSPENDED MATTER IN THE SURFACE WATERS OF THE ENGLISH CHANNEL [MOUVEMENTS ET CHARGES EN MATIERES EN SUSPENSION DES EAUX DE SURFACE DE LA MANCHE]

Y.-F. THOMAS (Ecole Normale Supérieure, Montrouge, France) IN: International Symposium on Remote Sensing of Environment, 18th, Paris, France, October 1-5, 1984, Proceedings. Volume 3. Ann Arbor, MI, Environmental Research Institute of Michigan, 1985, p. 1703-1713. In French. refs

Suspended matter in the surface waters of the English Channel was studied using Nimbus-7 Coastal Zone Color Scanner imagery. The imagery led to the identification of an eddy of about 3000 sq km that was predicted by numerical models. The large volume and high quality of the data (16 scenes for 1981) made it possible to determine the concentration of suspended matter over the annual cycle at each point of the Channel and to calculate a function describing the variation of this concentration. Large temporal variations of the concentration of suspended matter were observed under the combined effect of river discharges, tidal currents, and swell. B.J.

A86-21245#

DISPLAYING CZCS DATA IN 'TRUE COLOUR' MODE

M. VIOLLIER (CNRS, Station Biologique, Roscoff, France) and G. BELBEOCH (Centre National pour l'Exploitation des Océans, Brest, France) IN: International Symposium on Remote Sensing of Environment, 18th, Paris, France, October 1-5, 1984, Proceedings. Volume 3. Ann Arbor, MI, Environmental Research Institute of Michigan, 1985, p. 1727-1730. refs

On the Coastal Zone Color Scanner (CZCS) imagery, atmospheric effects usually mask the sea surface. To obtain useful information, atmospheric corrections are required. However, the current algorithms consume important computer-time. Furthermore, in some cases, results may be questionable due to uncertainties on the aerosol type and on the degradation of the radiometric calibration of the scanner. To test the reliability of the operations, a simple and practical way to discern some ocean-related features from atmospheric effects, consists in using a color composite of three channels (443, 520 and 670 nm). Author

A86-21268#

OBSERVATION AND STUDY OF ICE EDGE EDDY DYNAMICS IN THE EAST GREENLAND CURRENT AS SEEN FROM SATELLITE

A. M. COWAN, S. POLAR (Cambridge University, England), and K. A. ULBRICHT (DFVLR, Institut fuer Optoelektronik, Wessling, West Germany) IN: International Symposium on Remote Sensing of Environment, 18th, Paris, France, October 1-5, 1984, Proceedings. Volume 3. Ann Arbor, MI, Environmental Research Institute of Michigan, 1985, p. 1945-1954. refs

The ice cover of the East Greenland Current (EGC) represents the classic case of a marginal ice zone (MIZ). A mesoscale (smaller than 100 km) vortex has been closely studied, which appears to be spatially stationary. It is located in the Strait between Iceland and Greenland. An analysis of NOAA 6, 7, and 8, as well as Landsat satellite imagery shows the morphological and dynamical variation of the feature. Author

A86-21269#

CONSTRUCTION OF A HYPSONETRIC MODEL BY A DIACHRONIC ANALYSIS OF THREE SPOT SIMULATIONS [CONSTITUTION D'UN MODELE HYPSONETRIQUE PAR ANALYSE DIACHRONIQUE DE TROIS SIMULATIONS-SPOT]

F. CUQ (Ecole Normale Supérieure, Montrouge, France) IN: International Symposium on Remote Sensing of Environment, 18th, Paris, France, October 1-5, 1984, Proceedings. Volume 3. Ann Arbor, MI, Environmental Research Institute of Michigan, 1985, p. 1955-1960. In French.

The paper presents a method for constructing a hypsonetric model of a tide-balancing zone on the basis of a collection of high-spatial-resolution satellite images acquired at different moments of the tide. The modeling methodology is discussed in detail, and results are presented for three simulated SPOT images. B.J.

A86-21301* Jet Propulsion Lab., California Inst. of Tech., Pasadena.

METHODS OF SATELLITE OCEANOGRAPHY

R. H. STEWART (California Institute of Technology, Jet Propulsion Laboratory, Pasadena; California, University, Scripps Institution of Oceanography, San Diego) Research supported by Navy, University of California, and NASA. Berkeley, CA, University of California Press, 1985, 369 p. refs

The theoretical basis for remote sensing measurements of climate and ocean dynamics is examined. Consideration is given to: the absorption of electromagnetic radiation in the atmosphere; scattering in the atmosphere; and satellite observations using visible light. Consideration is also given to: the theory of radio scatter from the sea; scatter of centimeter waves from the sea; and the theory of operation of synthetic aperture radars. Additional topics include: the coordinate systems of satellite orbits for oceanographic remote sensing applications; the operating features of the major U.S. satellite systems for viewing the ocean; and satellite altimetry. I.H.

A86-22551

TRANSVERSE JETS IN COASTAL UPWELLINGS - SPACE-BASED DATA AND SOME PHYSICAL HYPOTHESES [SISTEMY POPERECHNYKH STRUI V PRIBREZHNYKH OPVELLINGAKH SPUTNIKOVAIA INFORMATSIIA I FIZICHESKIE GIPOTEZY]

A. I. GINZBURG and K. N. FEDOROV (AN SSSR, Institut Okeanologii, Moscow, USSR) Issledovanie Zemli iz Kosmosa (ISSN 0205-9614), Sept.-Oct. 1985, p. 3-10. In Russian. refs

The physical characteristics of near-surface water jets carrying cold coastal upwelling water into the ocean are inferred from satellite data and in situ measurements. The conditions leading to the formation of transverse jets are discussed in detail. It is shown that jet generation is possible wherever a source of fresh water is available. A novel hypothesis is advanced which attributes the origin of transverse jets to instability in the outer front of a coastal upwelling. An infrared NOAA-5 image showing a zone of coastal upwelling off the California-Oregon coast is provided. I.H.

A86-22553

DETERMINATION OF THE OPTICAL PARAMETERS OF THE LAND, OCEAN, AND ATMOSPHERE USING THE DATA OBTAINED ON BOARD THE SATELLITES INTERCOSMOS-20 AND INTERCOSMOS-21 [OPREDELENIE OPTICHESKIKH PARAMETROV ZEMNOI POVERKHNOSTI, OKEANA I ATMOSFERY SO SPUTNIKOV 'INTERKOSMOS-20 I -21']

V. V. BADAIEV, M. S. MALKEVICH (AN SSSR, Institut Kosmicheskikh Issledovaniy, Moscow, USSR), B. C. PIESIK, and G. ZIMMERMANN (Deutsche Akademie der Wissenschaften, Institut fuer Raumforschung, Berlin, East Germany) Issledovanie Zemli iz Kosmosa (ISSN 0205-9614), Sept.-Oct. 1985, p. 18-29. In Russian. refs

The results of a joint experiment conducted by the Soviet Union and East Germany in connection with the Intercosmos program are presented. The goals of the experiment were: to analyze satellite data concerning water surface spectral reflectance in order

to identify regions of high biological productivity; to assess the manner in which atmospheric turbidity affects remotely sensed data; and to verify methods determining the optical parameters of the atmosphere above the ocean. A brief description of the instrumentation and methodology of the experiment is given, and some examples of the remotely sensed data are presented. It is shown that the effects of the atmosphere on remotely sensed data can be estimated to within 15-20 percent. I.H.

A86-23119*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

CHARACTERISTICS OF ARCTIC WINTER SEA ICE FROM SATELLITE MULTISPECTRAL MICROWAVE OBSERVATIONS

J. C. COMISO (NASA, Goddard Space Flight Center, Greenbelt, MD) Journal of Geophysical Research (ISSN 0148-0227), vol. 91, Jan. 15, 1986, p. 975-994. NASA-supported research. refs

A coplanarity test using three scanning multichannel microwave radiometer channels shows the potential as well as the limitation of the sensor in discriminating different ice types. However, the capability for accurate determination of sea ice concentration, especially in the central Arctic, is evident from scatter plots of the emissivities using the two polarizations at 37 GHz. The consolidated ice data in the central Arctic form a very compact and linear set of points in these plots, and they slope the same way throughout the winter of 1979 and in other years (1980-1984). An ice concentration algorithm based on the utilization of this slope (about 1.03) is developed that yields retrieved values with an accuracy of about 5 percent in the central Arctic and 10 percent in the seasonal sea ice region. The total areal ice extent and actual ice cover were also derived from ice concentration retrieved by using the algorithm, and the results from several years of midwinter data show a relatively stable ice cover in the northern hemisphere. Author

A86-23291

COMPARISON OF SEA SURFACE TEMPERATURES OBTAINED FROM AN AIRCRAFT USING REMOTE AND DIRECT SENSING TECHNIQUES

P. A. SPYERS-DURAN (National Center for Atmospheric Research, Boulder, CO) and C. D. WINANT (California, University, La Jolla) Journal of Atmospheric and Oceanic Technology (ISSN 0739-0572), vol. 2, Dec. 1985, p. 667-671. refs
(Contract NSF OCE-83-10639)

A comparison of sea surface temperatures is made between aircraft precision radiation thermometer (PRT-5) and aircraft deployed expendable bathythermographs (AXBT) drops. These observations were obtained using the NCAR King Air aircraft for an experiment in the Gulf of California during March 1984. The average difference between the sea surface temperatures reported by the first temperature observed in each AXBT drop and the PRT-5 is -0.07 C with a standard deviation of 0.57 C. The difference in temperature between the two observations increases at lower wind speeds. Based on 116 case studies, differences of 1-2 C exist between the surface and the upper meter of the ocean when wind speeds are less than 5 m/s. Author

A86-24190

ERRORS IN MEASURING ICE THICKNESS BY AIRBORNE RADAR

V. V. BOGORODSKII and A. G. OGANESIAN (Arkticheskii i Antarkicheskii Nauchno-Issledovatel'skii Institut, Leningrad, USSR) (Zhurnal Tekhnicheskoi Fiziki, vol. 55, June 1985, p. 1159-1162) Soviet Physics - Technical Physics (ISSN 0038-5662), vol. 30, June 1985, p. 660-662. Translation. refs

It is shown that existing methods for measuring ice thickness by means of radar do not yield acceptable error estimates due to the lack of calibration methods and measuring standards. Some techniques for estimating rms errors are proposed. I.H.

A86-24773

TOPOGRAPHIC FEATURES OF THE BRISTOL CHANNEL SEA-BED - A COMPARISON OF SEASAT (SYNTHETIC APERTURE RADAR) AND SIDE-SCAN SONAR IMAGES

P. T. HARRIS, M. B. COLLINS, A. E. JAMES (Swansea, University College, Wales), and G. M. ASHLEY (Rutgers University, New Brunswick, NJ) *International Journal of Remote Sensing* (ISSN 0143-1161), vol. 7, Jan. 1986, p. 119-136. refs

Side-scan sonar data collected in 1977 and 1983 from the Bristol Channel are compared with 1978 SEASAT images, in order to determine the limiting physical dimensions of positive and negative topographic features detectable by SEASAT. The identification of sea-bed topography is related to a change in current speed which, in turn, is controlled by the relief: water-depth ratio. In a water depth of 45 m with a surface current speed of about 70 cm/s, for example, features greater than 11 m in relief and with a spacing greater than 500 m are visible. The widths of tone-change bands on SEASAT images are found to be related to the 'effective' widths of the topographic features that are modifying the flow conditions. The tone-change band sequence is related to positive and negative relief of the bed, under a particular current direction. Author

A86-24775

THE SATURATION OF LANDSAT MSS DETECTORS OVER LARGE ICE MASSES

J. A. DOWDESWELL (Cambridge University, England) and N. F. MCINTYRE (London, University College, Dorking, England) *International Journal of Remote Sensing* (ISSN 0143-1161), vol. 7, Jan. 1986, p. 151-164. NERC-supported research. refs

A model predicting the spatial and temporal pattern of Landsat Multispectral Scanner (MSS) detector saturation over the snow-covered surface of large ice masses is described. The relationship between MSS recorded radiance and the changes in sun elevation is analyzed. It is observed that MSS band five becomes saturated at the lowest sun angles; however, band seven remains unsaturated. The effects of atmospheric haze, the magnitude and orientation of surface slopes, variations in MSS radiometric calibration, and snow surface characteristics on detector saturation are studied. The spatial and temporal pattern of detector saturation is useful in the scheduling by NASA of the optimum periods to collect unsaturated MSS data of the polar regions. I.F.

A86-24934

REMOTE SENSING OF ATMOSPHERIC WATER VAPOUR FROM BHASKARA II SAMIR DATA AND ITS COMPARISON WITH NOAA-7 WATER VAPOUR DATA

P. N. PATHAK, B. S. GOHIL, and A. SARKAR (Indian Space Research Organization, Space Applications Centre, Ahmedabad, India) *Indian Academy of Sciences, Proceedings (Earth and Planetary Sciences)* (ISSN 0370-0089), vol. 94, Nov. 1985, p. 237-247. refs

Applying the method of 'statistical linear regression', atmospheric water vapour over oceanic areas has been estimated from the 19 GHz and 22 GHz data of the satellite microwave radiometer (SAMIR) system onboard the Bhaskara II satellite. In the absence of any simultaneous in situ measurements on water vapour over ocean, the SAMIR-derived water vapour data have been compared with like data from the NOAA-7 satellite. It is suggested that a positive bias seen in the SAMIR data could be due to calibration errors in the basic data. In view of the observed bias, the original regression equation is modified and then used to obtain water vapour distributions over ocean for winter and south-west monsoon seasons using SAMIR data of several orbits. Author

A86-25017

RECONNAISSANCE AND INTERPRETATION OF SEA COLORS [ERKUNDUNG UND INTERPRETATION DER MEERESFARBEN]

H. VAN DER PIEPEN, V. AMANN, and R. FIEDLER (DFVLR, Institut fuer Optoelektronik, Oberpfaffenhofen, West Germany) *DFVLR-Nachrichten* (ISSN 0011-4901), Nov. 1985, p. 21-26. In German. refs

Relations between the optical properties of water and the physical parameters of the water provide a basis for a study of oceans and other bodies of water. The present paper is concerned with the physical basis of such studies, their significance, history, the current state-of-the-art, and research undertaken to perfect the required technology, taking into account, in particular, the utilization of satellite-borne sensors. A great breakthrough with respect to water-color based remote sensing activities was made when the Coastal Zone Color Scanner (CZCS) on the satellite Nimbus-7 began to provide data in 1978. These data are extending the applications of remote sensing to entirely new areas, giving attention to important contributions regarding the study of the oceans and their economic utilization. Attention is given to research and development work conducted by the DFVLR in relation to the technology of ocean color analysis, the principles of measurement, the classification of different types of water, sensor technologies, applications, and future space missions. G.R.

A86-25371

EXTRACTION OF THE M2 OCEAN TIDE FROM SEASAT ALTIMETER DATA

P. L. WOODWORTH and D. E. CARTWRIGHT (Bidston Observatory, Birkenhead, England) *Geophysical Journal* (ISSN 0016-8009), vol. 84, Feb. 1986, p. 227-255. refs

Three complementary methods for the extraction of the M2 ocean tide using Seasat altimetry are presented and compared. The first method (that developed by Cartwright and Alcock), which provides 'point measurements' of the tide at the crossovers of the Seasat repeat orbit ground track, has been applied to a study of the tide in tropical ocean areas. The other two methods involve spatial expansions of M2 in terms of either surface spherical harmonics (in the case of the method developed by Mazzega) or Platzman normal modes of the world ocean. The results obtained by each method from only one month of Seasat data reproduce many features of the tide represented in recent tidal models, and promise well for satellite altimetry as a future source of tidal knowledge. Author

A86-26201* Florida State Univ., Tallahassee.

THE FRONTAL AIR-SEA INTERACTION EXPERIMENT (FASINEX). II - EXPERIMENTAL PLAN

S. A. STAGE (Florida State University, Tallahassee) and R. A. WELLER (Woods Hole Oceanographic Institution, MA) *American Meteorological Society, Bulletin* (ISSN 0003-0007), vol. 67, Jan. 1986, p. 16-20. Navy-NSF-NASA-NOAA-supported research.

The Frontal Air-Sea Interaction Experiment (FASINEX) is a study of the response of the upper ocean to atmospheric forcing in the vicinity of an oceanic front in the subtropical convergence zone southwest of Bermuda, the response of the lower atmosphere in that vicinity to the oceanic front, and the associated two-way interaction between ocean and atmosphere. FASINEX is planned for the winter and spring of 1985-1986 with an intensive period in February and March 1986 in the vicinity of 27 deg N, 70 deg W, where sea-surface temperature fronts are climatologically common. Measurements will be made from buoys, ships, aircraft, and spacecraft. A previous article gave a brief history of FASINEX and presented its scientific goals. This article describes the FASINEX experimental plan. Author

A86-27976

NATIONAL GROUP FOR THE PHYSICS OF THE ATMOSPHERE AND THE OCEANS, CONGRESS, 1ST, ROME, ITALY, JUNE 19-22, 1984, PROCEEDINGS [GRUPPO NAZIONALE PER LA FISICA DELL'ATMOSFERA E DELL'OCEANO, CONGRESSO, 1ST, ROME, ITALY, JUNE 19-22, 1984, PROCEEDINGS]

Nuovo Cimento C, Serie 1 (ISSN 0390-5551), vol. 8 C, Nov.-Dec. 1985, 392 p. In Italian and English. For individual items see A86-27977 to A86-27991.

Various papers on geophysics and space physics are presented. The topics discussed include: cooling processes and temperature profiles during nocturnal inversions, Nimbus 7 CZCS images as inputs in circulation modelling of the North Adriatic Sea, comparison of measured and calculated high-resolution spectra of far-infrared stratospheric emission, implications for the atmospheric sulfur budget of two-dimensional distributions of sulfur compounds in the troposphere, stratospheric heating due to El Chichon volcanic eruption, and measurements of atmospheric turbulence strength by coherent optical scintillation. Also considered are: study of stratospheric aerosol loading by lidar analysis of long and short-time fluctuations, stratospheric ozone descent into the troposphere, remote sensing of oils on the sea surface with an airborne infrared scanner, sea surface temperature from AVHRR-2 data, fine-mesh objective analysis scheme in isentropic coordinates, integrating nephelometer performance in fog and thick haze, and measurement and analysis of scattered radiation by a variable fov transmissometer. C.D.

A86-27985

REMOTE SENSING OF OILS ON THE SEA SURFACE WITH AN AIRBORNE INFRA-RED SCANNER

F. CASTAGNOLI, L. PANTANI, I. PIPPI, and B. RADICATI (CNR, Istituto di Ricerca sulle Onde Elettromagnetiche, Florence, Italy) (Gruppo Nazionale per la Fisica dell'Atmosfera e dell'Oceano, Congresso, 1st, Rome, Italy, June 19-22, 1984) Nuovo Cimento C, Serie 1 (ISSN 0390-5551), vol. 8 C, Nov.-Dec. 1985, p. 762-770. refs

The ability of an infrared sensor to detect oil spills over the sea surface is discussed on the basis of the first results of the Archimedes experiment of 1983. Two oil spills were made about 9 km apart, one consisting of pure fuel oil and the other of a stabilized mixture of fuel oil and water. The oil spill detection process is discussed, the experiment is summarized, and the image analysis is described. Images with different processing are shown. The results demonstrate the ability of an infrared scanner to monitor oil spills on the sea surface in real time during day or night. The only requirement is a transparent atmosphere. C.D.

A86-28064

ACOUSTIC OCEANOGRAPHY BY REMOTE SENSING

J. A. MERCER (Washington, University, Seattle) IEEE Journal of Oceanic Engineering (ISSN 0364-9059), vol. OE-11, Jan. 1986, p. 51-57. refs

The use of remotely stationed acoustic devices to study the interior of oceans is examined. The ocean-acoustic tomography method developed by Munk and Wunsch (1979) for remote monitoring of ocean basins for mesoscale and basin-scale variability is described. The applicability of ocean-acoustic tomography is evaluated in an experiment conducted in 1981. Calculated travel-time measurements are compared with speed-sound measurements derived from conductivity-temperature-depth/expendable bathythermographs of the tomography area. The problems encountered with the monitoring equipment during the experiment are discussed. It is observed that the limited tomographic results correlate with the speed-sound data. The tomography data is interpreted using the Cornuelle et al. (1975) stochastic inverse procedure. The sound-speed contour maps produced are accurate for a depth of 700 m; however, they degrade toward the ocean surface and bottom. The application of satellite altimeters and scatterometers, and grescale tomography to oceanography is proposed. I.F.

A86-28601* Washington Univ., Seattle.

ON SATELLITE SCATTEROMETER CAPABILITIES IN AIR-SEA INTERACTION

R. A. BROWN (Washington, University, Seattle) Journal of Geophysical Research (ISSN 0148-0227), vol. 91, Feb. 15, 1986, p. 2221-2232. refs
(Contract NAGW-303)

The verified capabilities and some practical usage of the satellite scatterometer in geophysical data production have demonstrated the value of this instrument. This evaluation of scatterometer ability to measure marine winds includes the scatterometer verification data, the state of the art planetary boundary layer model relating the wind profile in the atmosphere to the surface stress, and the pertinent results of the Storms Response Experiment. Author

A86-28607* Remote Sensing Systems, Sausalito, Calif.

NEW ALGORITHMS FOR MICROWAVE MEASUREMENTS OF OCEAN WINDS APPLICATIONS TO SEASAT AND THE SPECIAL SENSOR MICROWAVE IMAGER

F. J. WENTZ, L. A. MATTOX (Remote Sensing Systems, Sausalito, CA), and S. PETEHERYCH (Department of the Environment, Atmospheric Environment Service, Downsview, Canada) Journal of Geophysical Research (ISSN 0148-0227), vol. 91, Feb. 15, 1986, p. 2289-2307. Previously announced in STAR as N84-27272. refs

(Contract NASW-3606; N00014-83-C-0520)

Improved second generation wind algorithms are used to process the three month Seasat SMMR and SASS data sets. The new algorithms are derived without using in situ anemometer measurements. All known biases in the sensors prime measurements are removed, and the algorithms prime model functions are internally self-consistent. The computed SMMR and SASS winds are collocated and compared on a 10 km cell-by-cell basis, giving a total of 115444 wind comparisons. The comparisons are done using three different sets of SMMR channels. When the 6.6H SMMR channel is used for wind retrieval, the SMMR and SASS winds agree to within 1.3 m/s over the SASS primary swath. At nadir where the radar cross section is less sensitive to wind, the agreement degrades to 1.9 m/s. The agreement is very good for winds from 0 to 15 m/s. Above 15 m/s, the off-nadir SASS winds are consistently lower than the SMMR winds, while at nadir the high SASS winds are greater than SMMR's. When 10.7H is used for the SMMR wind channel, the SMMR/SASS wind comparisons are not quite as good. When the frequency of the wind channel is increased to 18 GHz, the SMMR/SASS agreement substantially degrades to about 5 m/s. Author

A86-28608

STRUCTURE OF THE SURFACE WIND FIELD FROM THE SEASAT SAR

T. W. GERLING (Johns Hopkins University, Laurel, MD) Journal of Geophysical Research (ISSN 0148-0227), vol. 91, Feb. 15, 1986, p. 2308-2320. Research supported by Johns Hopkins University. refs

The instruments carried by Seasat included a synthetic aperture radar (SAR) which is capable of producing radar images of both land and ocean with 25-m resolution. It is pointed out that any geophysical process which influences the 30-cm Bragg waves on the ocean surface will produce a signature in SAR imagery. The extraction of ocean surface wind speed and direction information from SAR imagery is discussed for a particular Seasat data set, taking into account pass 1339. The SAR wind direction signature is based on the kilometer-scale variation of SAR backscatter detectable through analysis of SAR image spectra. Attention is given to the Seasat pass 1339 data set, wind speed estimates with SAR, wind field estimates derived from SAR 6.4-km imagery, and a comparison of wind field estimates. G.R.

A86-28611* Johns Hopkins Univ., Laurel, Md. ALTIMETER HEIGHT MEASUREMENT ERROR INTRODUCED BY THE PRESENCE OF VARIABLE CLOUD AND RAIN ATTENUATION

F. M. MONALDO, J. GOLDBIRSH (Johns Hopkins University, Laurel, MD), and E. J. WALSH (NASA, Wallops Flight Center, Wallops Island, VA) *Journal of Geophysical Research* (ISSN 0148-0227), vol. 91, Feb. 15, 1986, p. 2345-2350. Previously announced in STAR as N84-27289. refs

It has recently been recognized that spatially inhomogeneous clouds and rain can substantially affect the height precision obtainable from a spaceborne radar altimeter system. Through computer simulation, it has been found that typical levels of cloud and rain intensities and associated spatial variabilities may degrade altimeter precision at 13.5 GHz and, in particular, cause severe degradation at 35 GHz. This degradation in precision is a result of radar signature distortion caused by variable attenuation over the beam limited altimeter footprint. Because attenuation effects increase with frequency, imprecision caused by them will significantly impact on the frequency selection of future altimeters. In this paper the degradation of altimeter precision introduced by idealized cloud and rain configurations as well as for a realistic rain configuration as measured with a ground based radar is examined. B.W.

A86-28613* Johns Hopkins Univ., Laurel, Md. SATELLITE TECHNIQUES FOR DETERMINING THE GEOPOTENTIAL OF SEA SURFACE ELEVATIONS

V. L. PISACANE (Johns Hopkins University, Laurel, MD) *Journal of Geophysical Research* (ISSN 0148-0227), vol. 91, Feb. 15, 1986, p. 2365-2371. NASA-supported research. Previously announced in STAR as N84-27298. refs

Spaceborne altimetry with measurement accuracies of a few centimeters which has the potential to determine sea surface elevations necessary to compute accurate three-dimensional geostrophic currents from traditional hydrographic observation is discussed. The limitation in this approach is the uncertainties in knowledge of the global and ocean geopotentials which produce satellite and height uncertainties about an order of magnitude larger than the goal of about 10 cm. The quantitative effects of geopotential uncertainties on processing altimetry data are described. Potential near term improvements, not requiring additional spacecraft, are discussed. Even though there is substantial improvements at the longer wavelengths, the oceanographic goal will be achieved. The geopotential research mission (GRM) is described which should produce geopotential models that are capable of defining the ocean geoid to 10 cm and near-earth satellite position. The state of the art and the potential of spaceborne gravimetry is described as an alternative approach to improve our knowledge of the geopotential. E.A.K.

A86-28614# DYNAMIC TRANSFER OF SIMULATED ALTIMETER DATA INTO SUBSURFACE INFORMATION BY A NUMERICAL OCEAN MODEL

H. E. HURLBURT (U.S. Navy, Naval Ocean Research and Development Activity, Bay St. Louis, MS) *Journal of Geophysical Research* (ISSN 0148-0227), vol. 91, Feb. 15, 1986, p. 2372-2400. Navy-sponsored research. refs

The potential for a global, eddy-resolving oceanic prediction capability within the next decade has been examined by Hurlburt (1984). The present study is concerned with a prediction system which is mainly based on satellite data, output from atmospheric models, a class VII computer (approximately 100 million words and approximately 1 gigaflop sustained speed), and highly efficient ocean models. Problems regarding the application of altimeter data to ocean circulation prediction are related to spatial and temporal sampling requirements, synoptic data assimilation, uncertainty in the data including geoid errors, and the inference of subsurface information from the surface data provided by altimeters. Attention is given to the numerical model employed and the parameters, aspects of experimental approach and interpretation, model

experiments used as true solutions, and the results form some experiments. G.R.

A86-28615# ALTIMETER DATA AND GEOID ERROR IN MESOSCALE OCEAN PREDICTION SOME RESULTS FROM A PRIMITIVE EQUATION MODEL

J. D. THOMPSON (U.S. Navy, Naval Ocean Research and Development Activity, Bay St. Louis, MS) *Journal of Geophysical Research* (ISSN 0148-0227), vol. 91, Feb. 15, 1986, p. 2401-2417. Navy-supported research. refs

It is pointed out that the radar altimeter (GEOS 3, Seasat) is the only proven satellite-borne instrument capable of synoptically measuring an integral property of the dynamic ocean on a near-global, all-weather basis. The present paper is mainly concerned with the application of a primitive equation ocean model to the study of sea surface height information derived from an altimeter. It is demonstrated that in the Gulf of Mexico this technique can provide a geoid which is more accurate than that which is currently available from direct calculations on the basis of sparse shipboard gravity data or from an approach involving the differencing of the altimetric mean sea surface with dynamic heights based on available hydrographic data. Attention is given to Gulf of Mexico data, the Gulf of Mexico model, and initialization experiments. G.R.

A86-28616# SAMPLING STRATEGIES AND MODEL ASSIMILATION OF ALTIMETRIC DATA FOR OCEAN MONITORING AND PREDICTION

J. C. KINDLE (U.S. Navy, Ocean Dynamics and Prediction Branch, Bay St. Louis, MS) *Journal of Geophysical Research* (ISSN 0148-0227), vol. 91, Feb. 15, 1986, p. 2418-2432. Navy-supported research. refs

A one-layer, reduced gravity primitive equation model of the Gulf of Mexico is used in the present examination of altimeter-derived sea surface height assimilations into numerical ocean circulation models for numerical forecasting. The data allow examination of spatial sampling requirements for accurate resolution of oceanic eddies, as well as the assimilation of synoptic altimeter data into numerical models in the forecast mode. The results obtained indicate that for a stationary circular eddy, approximately two tracks across the eddy are enough to ensure adequate spatial resolution. It is also noted that if the track spacing is sufficient for resolution of the height field of an eddy, the along-track geostrophic velocity component is determined with an accuracy that is equivalent to that of the cross-track component. O.C.

A86-28617* Johns Hopkins Univ., Laurel, Md. SPATIAL VARIATIONS OF OCEAN WAVE DIRECTIONAL SPECTRA FROM THE SEASAT SYNTHETIC APERTURE RADAR

R. C. BEAL, T. W. GERLING, D. E. IRVINE, F. M. MONALDO, and D. G. TILLEY (Johns Hopkins University, Laurel, MD) *Journal of Geophysical Research* (ISSN 0148-0227), vol. 91, Feb. 15, 1986, p. 2433-2449. Navy-NASA-supported research. refs

Seasat synthetic aperture radar ocean wave spectra for a 900-km pass are analyzed and interpreted in the context of both their probable generation sources and their surface current and bathymetric modifiers. Systematic vector wavenumber variations of several times the standard error of determination (about 1.5 percent in magnitude and 0.9 deg in direction) occur along the entire 900-km pass. The large-scale spatial variation of a 200-m swell system can be accurately accounted for as a result of dispersion from a distant storm. The more local variations are qualitatively well correlated in position with known currents and bathymetry but show systematic biases that appear partly due to an environmentally dependent instrument transfer function in the regions of high current and highest sea state. There is also substantial evidence that a large angular deviation in the center of the pass is the result of a mesoscale eddy just to the east.

Author

A86-28618* Hofstra Univ., Hempstead, N. Y.
MEASUREMENTS OF OCEAN WAVE SPECTRA AND MODULATION TRANSFER FUNCTION WITH THE AIRBORNE TWO-FREQUENCY SCATTEROMETER

D. E. WEISSMAN (Hofstra University, Hempstead, NY) and J. W. JOHNSON (NASA, Langley Research Center, Hampton, VA) *Journal of Geophysical Research* (ISSN 0148-0227), vol. 91, Feb. 15, 1986, p. 2450-2460. Previously announced in STAR as N84-27282. refs
 (Contract NAGW-468)

The directional spectrum and the microwave modulation transfer function of ocean waves can be measured with the airborne two frequency scatterometer technique. Similar to tower based observations, the aircraft measurements of the Modulation Transfer Function (MTF) show that it is strongly affected by both wind speed and sea state. Also detected are small differences in the magnitudes of the MTF between downwind and upwind radar look directions, and variations with ocean wavenumber. The MTF inferred from the two frequency radar is larger than that measured using single frequency, wave orbital velocity techniques such as tower based radars or ROWS measurements from low altitude aircraft. Possible reasons for this are discussed. The ability to measure the ocean directional spectrum with the two frequency scatterometer, with supporting MTF data, is demonstrated.

M.A.C.

A86-28620* Jet Propulsion Lab., California Inst. of Tech., Pasadena.

SATELLITE REMOTE SENSING OVER ICE

R. H. THOMAS (California Institute of Technology, Jet Propulsion Laboratory, Pasadena) *Journal of Geophysical Research* (ISSN 0148-0227), vol. 91, Feb. 15, 1986, p. 2493-2502. NASA-supported research. Previously announced in STAR as N84-27308. refs

Satellite remote sensing provides unique opportunities for observing ice-covered terrain. Passive-microwave data give information on snow extent on land, sea-ice extent and type, and zones of summer melting on the polar ice sheets, with the potential for estimating snow-accumulation rates on these ice sheets. All weather, high-resolution imagery of sea ice is obtained using synthetic aperture radars, and ice-movement vectors can be deduced by comparing sequential images of the same region. Radar-altimetry data provide highly detailed information on ice-sheet topography, with the potential for deducing thickening/thinning rates from repeat surveys. The coastline of Antarctica can be mapped accurately using altimetry data, and the size and spatial distribution of icebergs can be monitored. Altimetry data also distinguish open ocean from pack ice and they give an indication of sea-ice characteristics. Author

A86-28623
PROBLEMS AND FUTURE DIRECTIONS IN REMOTE SENSING OF THE OCEANS AND TROPOSPHERE - A WORKSHOP REPORT

D. ATLAS (Maryland, University, College Park), R. C. BEAL (Johns Hopkins University, Laurel, MD), R. A. BROWN (Washington, University, Seattle), P. DE MEY (Harvard University, Cambridge, MA), R. K. MOORE (Kansas, University, Lawrence) et al. *Journal of Geophysical Research* (ISSN 0148-0227), vol. 91, Feb. 15, 1986, p. 2525-2548. refs
 (Contract NSF ATM-84-14199)

Attempts to identify the gaps and limitations in the ability to remotely sense the oceans and troposphere from air and space platforms are presented. The directions that offer solutions and new opportunities for advancing the state of the art are set down. The needs are clearly related to the scientific problems. Special attention is given to the synergistic benefits of simultaneous observations because of the interdependence of the remotely sensed parameters and the problem areas to which they are directed. Emphasis is also given to the adaptation of spaceborne remote sensing to aircraft platforms and vice versa. The problem areas covered are (1) directional ocean wave spectra, (2) ocean surface winds, (3) ocean circulation, (4) sea ice, (5) a subset of atmospheric measurements, and (6) air-sea interaction. Author

A86-28624* California Univ., La Jolla.
ON CROSSOVER ADJUSTMENT IN SATELLITE ALTIMETRY AND ITS OCEANOGRAPHIC IMPLICATIONS

C.-K. TAI (California University, La Jolla) and L.-L. FU (California Institute of Technology, Jet Propulsion Laboratory, Pasadena) *Journal of Geophysical Research* (ISSN 0148-0227), vol. 91, Feb. 15, 1986, p. 2549-2554. refs
 (Contract NAGW-663)

It is argued that, to remove the satellite orbital errors, the crossover adjustment method that represents orbital errors in terms of Fourier series is preferable to the conventional bias-and-tilt crossover adjustment method. However, no matter what technique is used in the crossover adjustment, orbital errors will introduce a geographically dependent error (mostly a large-scale slope, which, in terms of spherical harmonics, is represented by the degree 1 terms) into the derived sea surface topography. This is because the responsible orbital errors have left no traces in crossover differences and therefore can never be removed. However, it is possible to reduce this fundamental uncertainty substantially if the record length is long enough; its implications on observing the basin-scale ocean circulation by satellite altimetry are discussed. New methods for observing the large-scale oceanic variability are also proposed (the conventional approach being limited to observing the mesoscale variability). Author

A86-28626
PERSISTENCE OF A PATTERN OF SURFACE GRAVITY WAVES

K. M. WATSON (California, University, San Diego) *Journal of Geophysical Research* (ISSN 0148-0227), vol. 91, Feb. 15, 1986, p. 2607-2615. Research supported by the Mitre Corp. refs
 (Contract F19628-84-C-0001; N00014-79-C-0472)

The observation of ship Kelvin wakes by the Seasat synthetic aperture radar raises a question concerning the persistence of patterns of surface gravity waves. Time scales vary with wavelength and environmental conditions. The range extends from fractions of a second at the shortest wavelengths to many days for ocean swell. Several mechanisms for destroying a wave pattern are investigated here. These are viscous dissipation, direct wind-wave interaction, and nonlinear hydrodynamic interaction with ambient surface waves. The nonlinear hydrodynamic interactions appear to be the most significant. Author

A86-28629
ASPECTS OF WARM RINGS IN THE GULF OF MEXICO

F. M. VUKOVICH and B. W. CRISSMAN (Research Triangle Institute, Research Triangle Park, NC) *Journal of Geophysical Research* (ISSN 0148-0227), vol. 91, Feb. 15, 1986, p. 2645-2660. Research supported by the Science Applications International Corp. refs

The paths, speed, and decay of major warm rings that separate from the Loop Current are studied using satellite infrared and Ship-of-Opportunity data. It is observed that after the warm rings separate they move into the western portion of the Gulf of Mexico following a northern, midgulf, or southwestern path. The oscillations in the speed of the rings, which ranges from 1-8 km/day for 40-100 days, are analyzed. A description of the two ring decay process which involve erosion of the rings at the boundaries and the separation of smaller rings from the main ring is provided. It is detected that the surface areas of the rings decrease to 55 percent of their original size after 150 days and to 31 percent of their size in 300 days. I.F.

N86-16685# National Oceanic and Atmospheric Administration, Boulder, Colo.

MARGINAL ICE ZONE BIBLIOGRAPHY

Jun. 1985 199 p
 (PB85-242493; GD-17) Avail: NTIS HC A09/MF A01 CSCL 08L

A major bibliography on sea ice, meteorology and oceanography in the marginal ice zone is provided. It has been recognized in the last few years that processes of air-ice-ocean interaction occurring near the boundary of ice-covered seas are of critical

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importance to our understanding of the mechanisms of seasonal ice growth and decay and short and long term anomalies in ice extent. Oil and gas exploration and development are increasingly being conducted in areas with seasonal ice cover and the ice margin is also a zone of high productivity by marine biota. Until recently, opportunities to conduct research in the marginal ice zone (MIZ) were limited by available technology, but a major international marginal ice zone experiment (MIZEX) is underway in the Bering Sea and the East Greenland Sea and results from this work are now beginning to appear in the literature. GRA

N86-16697*# Oklahoma Univ., Norman. Cooperative Inst. for Mesoscale Meteorological Studies.

DEVELOPMENT OF THE VARIATIONAL SEASAT DATA ANALYSIS TECHNIQUE Final Report

Y. K. SASAKI, L. P. CHANG, and J. S. GOERSS Dec. 1985 80 p refs

(Contract NAG5-289)

(NASA-CR-176471; NAS 1.26:176471) Avail: NTIS HC A05/MF A01 CSCL 05B

Surface winds are closely associated with the surface pressure gradient. The variational SEASAT data analysis technique was designed to improve the sea level pressure analysis in the data sparse areas. The SEASAT-derived surface wind data were compared with observations from the Joint Air Sea Interaction Experiment (JASIN) and it was found that the satellite-derived sea surface wind has an accuracy of up to + or - 2 m/s in speed and + or - 20 deg in direction. These numbers are considered characteristic of the retrieved SEASAT wind field. By combining the densely spaced SEASAT-derived wind data with the sparsely distributed sea-level pressure observation via a variational adjustment technique subject to some appropriate physical constraint(s), an improvement in the sea-level pressure analysis is expected. It is demonstrated that a simple marine boundary layer scheme in conjunction with a variational adjustment technique can be developed to help improve the sea-level pressure analysis by the SEASAT-derived wind of a limited-area domain in the ocean. E.A.K.

N86-16855*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.

SATELLITE-DERIVED SEA SURFACE TEMPERATURE: WORKSHOP 3

15 Oct. 1985 181 p refs Workshop held in Pasadena, Calif., 22-24 Feb. 1984. Original contains color illustrations 3 Vol. (Contract NAS7-918)

(NASA-CR-176455; JPL-PUB-85-63; NAS 1.26:176455) Avail: NTIS HC A09/MF A01 CSCL 08J

This is the third of a series of three workshops, sponsored by the National Aeronautics and Space Administration, to investigate the state of the art in global sea surface temperature measurements from space. Three workshops were necessary to process and analyze sufficient data from which to draw conclusions on the accuracy and reliability of the satellite measurements. In this workshop, the final two (out of a total of four) months of satellite and in situ data chosen for study were processed and evaluated. Results from the AVHRR, HIRS, SMMR, and VAS sensors, in comparison with in situ data from ships, XBTs, and buoys, confirmed satellite rms accuracies in the 0.5 to 1.0 C range, but with variable biases. These accuracies may degrade under adverse conditions for specific sensors. A variety of color maps, plots, and statistical tables are provided for detailed study of the individual sensor SST measurements.

N86-16856*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.

DATA SETS AND PRODUCTS

J. E. HILLAND and E. G. NJOKU *In its* Satellite-Derived Sea Surface Temperature 12 p 15 Oct. 1985 refs

Avail: NTIS HC A09/MF A01 CSCL 08J

Against background of spacecraft and in situ measurements, participants at the JPL workshops sought to review the sensor performance, understand the different SST retrieval algorithms,

evaluate the sensor SST accuracies, and discuss directions for future sensor development. The issue of utilization of satellite SSTs in climate, air sea interaction, and mesoscale oceanography studies was not the main focus of the workshops, but did have a bearing on the recommendations that arose from the discussions. More data were available for analysis with the acquisition of AVHRR (MCSST), HIRS/MSU, and VAS data sets. In Workshop 3 the acquisition and analysis of data were completed, recommendations for future research and sensor development were discussed, and plans were made for eventual publication of results from the workshop series in the open literature. Author

N86-16857*# National Oceanic and Atmospheric Administration, Washington, D. C. National Environmental Satellite, Data, and Information Service.

ADVANCED VERY HIGH RESOLUTION RADIOMETER (AVHRR) SENSOR COMPARISON CHARACTERISTICS

E. P. MCCLAIN *In* JPL Satellite-Derived Sea Surface Temperature 17 p 15 Oct. 1985 refs

Avail: NTIS HC A09/MF A01 CSCL 08J

Advantages and limitations of the AVHRR multichannel sea surface temperature (MCSST) detecting technique using NOAA satellites are discussed. The error characteristics of MCSST's from statistical tables and regional AVHRR error characteristics from global anomaly charts are also discussed. Some sources of errors and positive findings are reviewed. E.R.

N86-16858*# National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.

RETRIEVAL OF SEA-SURFACE TEMPERATURES FROM HIRS2/MSU

J. SUSSKIND and D. REUTER *In* JPL Satellite-Derived Sea Surface Temperature 18 p 15 Oct. 1985 refs

Avail: NTIS HC A09/MF A01 CSCL 08J

The methods used at the Goddard Laboratory for Atmospheres to retrieve sea surface temperatures from HIRS2/MSU data for the four months of the NASA sea surface temperature intercomparison workshop are described. Results are shown comparing anomaly fields produced using data from ships, AVHRR, HIRS2/MSU, SMMR AND VAS for the last three of these months. Fields from AVHRR and HIRS2 show the highest accuracy compared to ship fields. Errors in the HIRS2 fields appear more random while AVHRR data shows large area, spatially coherent errors. The random errors in the HIRS2 fields can be further reduced by performing the retrievals at a higher spatial resolution. Author

N86-16859*# Wisconsin Univ., Madison. Space Science and Engineering Center.

SEA SURFACE TEMPERATURES FROM VAS MSI DATA

J. J. BATES *In* JPL Satellite-Derived Sea Surface Temperature 7 p 15 Oct. 1985 refs

Avail: NTIS HC A09/MF A01 CSCL 08J

The results of the SST intercomparison workshop series are the first examination of monthly mean SSTs derived from MSI data provided by the VAS instrument on the GOES series satellites. The most significant change in deriving the SST's was the use of the three window channel algorithm in the processing of the July data as opposed to the use of only the two window channel algorithm for the March data. In addition, further satellite/buoy matches indicated that the triple window channel algorithm showed a smaller standard deviation than the two window channel algorithm and was less sensitive to the effects of volcanic aerosol contamination and low level inversion conditions. This is due to the smaller brightness temperature attenuation by aerosols and water vapor at 3.9 microns than at 11.0 and 12.6 microns. Thus, the decision was made to use the best product (i.e., the three window channel algorithm) for processing the July data. Author

N86-16860*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
BLENDED SST FIELDS COMBINED SMMR/SHIP DATA (SUMMARY OF TECHNIQUE)

T. T. WILHEIT and D. HAN (Systems and Applied Sciences Corp., Hyattsville, Md.) *In* JPL Satellite-Derived Sea Surface Temperature 5 p 15 Oct. 1985 refs

Avail: NTIS HC A09/MF A01 CSCL 08J

All remote sensors have bias problems which vary in space and time. The infrared measurements are very sparse in cloudy areas: the SMMR has coverage limitations due to the interference of land areas and only half time operation. If one simply averaged the data from these various sources, the combination of the biases and varying sampling would introduce artifacts into the analyzed product which would reflect the sampling and which could be quite misleading. The remote sensors provide reasonable estimates of gradients of SST over length scales greater than the sensor resolution but smaller than hemispheric. Ships can be considered unbiased but are poorly distributed on small scales except in the densest shipping lanes. An analysis scheme based on a suggestion by Holl was developed which exploits just this approximately complementarity to provide an improved SST analysis. The resulting accuracy appears to be in the required approx. 0.5 C range for the particular case of using SMMR and ship data to produce two degree latitude by two degrees longitude monthly analyses.

Author

N86-16861*# Scripps Institution of Oceanography, La Jolla, Calif.

INTERCOMPARISON OF GLOBAL SST FIELDS DERIVED FROM SATELLITE SENSORS AND SHIP OBSERVATIONS

S. E. PAZAN *In* JPL Satellite-Derived Sea Surface Temperature 13 p 15 Oct. 1985 refs

Avail: NTIS HC A09/MF A01 CSCL 08J

Near global comparisons were made between binned forms of SST obtained from different instruments, ship meteorological observations, and the output of a meteorological model. Binning hereinafter means gridding by simple summation of data values in a bin, which in this study was a 2 deg. x 2 deg. box or a 10 deg. x 10 box surrounding a grid node. In the binned comparisons, the question is asked: are the binned data from two instruments drawn from the same population? The first two measures of statistical moments of the populations are used to test the hypothesis that they are. Comparisons were also attempted between raw forms of the various SST retrievals, using a structure function analysis. The results of this analysis were relatively uninteresting and are therefore omitted.

Author

N86-16862*# Western Australian Inst. of Tech., Bentley. School of Physics and Geosciences.

REQUIREMENTS FOR SEA SURFACE TEMPERATURE GROUND TRUTH IN THE INDONESIAN REGION

J. PENROSE *In* JPL Satellite-Derived Sea Surface Temperature 2 p 15 Oct. 1985 refs

Avail: NTIS HC A09/MF A01 CSCL 08J

The comparatively low density of ship and XBT observations in large areas of the Southern Hemisphere and the tropics limits the extent to which satellite SST estimates can be validated on a global basis. These limitations are discussed, and some recommendations for correction are given.

E.R.

N86-16873# SES, Inc., Springfield, Va.
PATHWAYS AND FUTURE DIRECTIONS FOR ENVIRONMENTAL DATA AND INFORMATION USERS

Oct. 1984 433 p Proceedings of conference held in Denver, Colo., 19-22 Aug. 1984

(Contract NA83-SA-C-00754)

(PB85-233377; NESDIS-CONF-84-2) Avail: NTIS HC A19/MF A01 CSCL 08J

The interdisciplinary use of environmental data and information available from NOAA's National Environmental Satellite, Data, and Information Services (NESDIS) data centers are presented. Topical areas include activities as: (1) legal and insurance industries; (2)

business, commodities, manufacturing, travel and recreation, (3) public and environmental health; (4) communications; (5) the marine environment, research and academia; disaster preparedness, and resource management. Future plans for on-line services and the technology transfer program of NOAA are described. GRA

N86-16874# National Oceanic and Atmospheric Administration, Washington, D. C. Oceanographic and Meteorological Labs.

ATLANTIC OCEANOGRAPHIC AND METEOROLOGICAL LABORATORY, FISCAL YEAR 1984 Annual Report

Jan. 1985 62 p

(PB85-218014) Avail: NTIS HC A04/MF A01 CSCL 08C

The mission NOAA's Atlantic Oceanographic and Meteorological Laboratory (AOML) is to conduct a basic and applied research program in oceanography characteristics and processes of the ocean and the atmosphere both separately and as a coupled system. Oceanographic investigations center on the fluxes of energy, momentum, and materials through the air-sea interface; the transport and composition (thermal and chemical) of water in the ocean volume; and hydrothermal processes of mineralization at seafloor spreading centers. Meteorological research is carried out to improve the description, understanding, and prediction of hurricanes. GRA

N86-17722# Rijkswaterstaat, The Hague (Netherlands). Meetkundige Dienst.

THE UTILIZATION OF FALSE COLOR AERIAL PHOTOGRAPHY FOR MACROPHYTE BIOMASS ESTIMATION IN THE OOSTERSCHDELDE (THE NETHERLANDS) [HET GEBRUIK VAN FALSE COLOURLUCHTFOTOGRAFIE BIJ DE SCHATTING VAN DE MACROFYTENBIOMASSA IN DE OOSTERSCHDELDE]

C. MEULSTEE and H. VANSTOKKOM Jan. 1985 28 p refs *In* DUTCH

(MDLK-R-8509) Avail: NTIS HC A03/MF A01

The correlation between the biomass of sea grass and seaweed samples in a sidebranch of the Oosterschelde delta (Netherlands) and density ratios of this area on color infrared aerial photographs was investigated. As the Oosterschelde will become more divided from the North Sea after pier dam completion, an increase of macrophytes is expected. In an area where the weeds *Ulva*, *Cheatomorpha*, *Enteromorpha*, *Cladophora*, *Fucus vesiculosus*, and the grasses *Zostera noltii* and *Zostera marina* are found, 53 biomass samples of a 0.054 sq m surface each were collected. The relation between covering degree and biomass was estimated. Using a transmission-densitometer adjusted to 3 to 1 mm, densities on 1:10,000 and 1:20,000 scale photographs were measured. A gage line was determined in a density-biomass diagram. The method is shown to be useful for an efficient, accurate biomass determination in the Oosterschelde. Author (ESA)

N86-17817*# National Aeronautics and Space Administration, Washington, D.C.

SATELLITE REMOTE SENSING FOR ICE SHEET RESEARCH

R. H. THOMAS, R. A. BINDSCHADLER (NASA, Goddard Space Flight Center, Greenbelt, Md.), R. L. CAMERON (NSF, Washington, D.C.), F. D. CARSEY (JPL, Pasadena, Calif.), B. HOLT (JPL, Pasadena, Calif.), T. J. HUGHES (Maine Univ.), C. W. M. SWITHINBANK (British Antarctic Survey, Cambridge, England), I. M. WHILLANS (Ohio State Univ.), and H. J. ZWALLY (NASA, Goddard Space Flight Center, Greenbelt, Md.) Nov. 1985 40 p refs Original contains color imagery. Original photographs may be purchased from the EROS Data Center, Sioux Falls, S.D. 57187 ERTS

(E86-10024; NASA-TM-86233; REPT-85F0298; NAS 1.15:86233)

Avail: NTIS HC A03/MF A01 CSCL 08L

Potential research applications of satellite data over the terrestrial ice sheets of Greenland and Antarctica are assessed and actions required to ensure acquisition of relevant data and appropriate processing to a form suitable for research purposes are recommended. Relevant data include high-resolution visible and SAR imagery, infrared, passive-microwave and scatterometer measurements, and surface topography information from laser and radar altimeters. Author

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N86-17823# University Coll., London (England). Mullard Space Science Lab.

APPLICATIONS AND SCIENTIFIC USES OF ERS-1 RADAR ALTIMETER DATA Final Report

C. G. RAPLEY, H. D. GRIFFITHS, V. A. SQUIRE (Cambridge Univ.), J. G. OLLIVER (Oxford Univ.), A. R. BIRKS (Science and Engineering Research Council, Chilton, England), A. P. R. COOPER (Cambridge Univ.), A. M. COWAN (Cambridge Univ.), D. J. DREWRY (Cambridge Univ.), M. R. GORMAN (Cambridge Univ.), M. GUZKOWSKA (Oxford Univ.) et al. Paris ESA Feb. 1985 276 p refs

(Contract ESTEC-5684/83/NL-BI)

(ESA-CR(P)-2084) Avail: NTIS HC A13/MF A01

Applications of the ERS-1 pulse-limited radar altimeter dedicated to observations of oceans and ice are discussed. Areas in which the ERS-1 altimeter is likely to be most effective are indicated. Status of the data analysis techniques and the limitations imposed by the design of the altimeter system are described. A concept for the use of altimeter data from lakes for climate research, and work on the altimetry of coastal regions are summarized.

Author (ESA)

N86-17970# Naval Ocean Research and Development Activity, Bay St. Louis, Miss.

BIBLIOGRAPHY OF RESEARCH ON OCEAN FRONTS, 1964-1984 Final Report

L. B. GILHAM, J. J. MIKA, and D. A. WIESENBURG Aug. 1985 58 p

(AD-A160040; NORDA-TN-303) Avail: NTIS HC A04/MF A01 CSCL 08J

This report contains a bibliography of published papers describing research related to oceanic fronts. The citations cover research on physical, chemical and biological oceanographic studies of ocean fronts and also observations made by remote sensing. The papers listed cover the period from 1964 to 1984. A few earlier papers, considered classics, are also included. This bibliography was assembled as the first step in a program to study the dynamic chemical processes associated with ocean frontal boundaries. Over 750 citations are included. GRA

N86-17971# World Meteorological Organization, Geneva (Switzerland).

INTERNATIONAL LIST OF SELECTED, SUPPLEMENTARY AND AUXILIARY SHIPS

1985 403 p In ENGLISH and FRENCH

(WMO-47-ED-85) Avail: NTIS MF A01; hard copy available at WMO, Geneva, SWFR 37

The names, country of origin, instruments, operating conditions, number of radio operators, and call signs of ships in the World Meteorological Organization Observing Ship Scheme are listed. The method of obtaining sea surface temperature is indicated.

Author (ESA)

N86-17972# European Space Agency, Paris (France). PIPOR Science Working Group.

A PROGRAM FOR INTERNATIONAL POLAR OCEANS RESEARCH (PIPOR) Final Report

B. BATTRICK, ed. and E. ROLFE, ed. Sep. 1985 47 p refs Original contains color illustrations

(ESA-SP-1074) Avail: NTIS HC A03/MF A01

The importance of polar regions in atmospheric and oceanic circulation is outlined, and a polar regions research program is proposed. Real-time, high resolution satellite data on ice distribution and characteristics are essential to a variety of application areas. Synthetic aperture radar data must be acquired over the entire polar region in a quantity sufficient to monitor significant geophysical processes. For optimal all-weather monitoring of the polar regions, satellite SAR data must be coupled with passive microwave data and augmented by measurements from in-situ, autonomous data-collection systems. Satellite observations must be validated through comparisons with measurements made by surface parties, airborne remote sensing, and submarines. Ocean buoy technology should be developed to provide expanded atmospheric and oceanic

observations. High-quality hydrographic and geochemical measurements in the polar oceans will contribute significantly to understanding of ocean circulation. Modeling research in air-sea-ice interaction should be expanded. Author (ESA)

N86-18028# Institute of Oceanographic Sciences, Wormley (England).

A STUDY OF ERS-1 RADAR ALTIMETER DATA PROCESSING REQUIREMENTS Final Report

T. H. GUYMER, D. J. T. CARTER, P. G. CHALLENGER, M. A. SROKOSZ (University College, London), A. R. TABOR (Centre National pour l'Exploitation des Oceans), C. G. RAPLEY, N. F. MCINTYRE (University College, London), R. F. SCOTT (University College, London), H. D. GRIFFITHS (University College, London), and P. QUEFFEULOU Paris ESA Jan. 1985 268 p refs (Contract ESA-5681/83/NL-BI)

(ESA-CR(P)-2073) Avail: NTIS HC A12/MF A01

Data processing for the ERS-1 radar altimeter over oceans and sea ice for fast delivery products (near real time processing, onboard or at the ground station) and off line products is discussed. Useful products are identified and, the status of algorithms for extracting the relevant geophysical parameters from sensor data is reviewed. Suggestions concerning retrievals from ERS-1 data taking into account differences between ERS-1 and SEASAT are made. Problems concerning the extraction of wind speed, and the effects of sea surface nonlinearities are considered, and parameters, including a wave period, are proposed. Implications for the overall radar altimeter ground segment philosophy, including the accessibility and dissemination of products and standardization of formats are outlined. Author (ESA)

N86-18352# Mullard Space Science Lab., Dorking (England).

A RADAR ALTIMETER AND THE VALIDATION OF ITS DATA PRODUCTS OVER ICE SURFACES

N. F. MCINTYRE, R. J. POWELL (Science Research Council, Chilton, England), and V. A. SQUIRE (Scott Polar Research Inst., Cambridge, England) In ESA Proceedings of EARSeL/ESA Symposium on European Remote Sensing Opportunities: Systems, Sensors, and Applications p 3-11 Jun. 1985 refs Sponsored by UK National Environment Council and UK Science and Engineering Research Council

Avail: NTIS HC A12/MF A01

A 13.81 GHz pulsed radar altimeter was flown on a Convair 990 during the Marginal Ice Zone Experiment in the Bering Sea and Greenland Sea. It was used in 10 different operating modes involving combinations of transmit/receive polarizations, nadir-pointing horn antennas and a steerable parabolic antenna. Averaging of returned pulses over nonuniform surfaces was studied in a program to validate altimeter data products over ice surfaces. Correlations of altimeter waveforms with helicopter photography indicate that algorithms for extracting concentration and other sea ice parameters are feasible. Coverage of previously surveyed profiles may also enable better characterization of ice sheet surfaces. The application of results is useful for geophysical interpretation of ERS-1's radar altimeter. Author (ESA)

N86-18370# Consiglio Nazionale delle Ricerche, Florence (Italy). Ist. di Ricerca sulle Onde Elettromagnetiche.

REMOTE SENSING OF OIL ON SEA: LIDAR AND PASSIVE IR EXPERIMENTS

F. CASTAGNOLI, G. CECCHI, L. PANTANI, I. PIPPI, B. RADICATI, C. SUSINI, P. MAZZINGHI, and A. BARBARO In ESA Proceedings of EARSeL/ESA Symposium on European Remote Sensing Opportunities: Systems, Sensors, and Applications p 121-126 Jun. 1985 refs

Avail: NTIS HC A12/MF A01

A compact system for detecting and monitoring oil pollution on the sea from light aircraft using passive infrared remote sensing was developed. Lidar marine environment and pollution monitoring potential was assessed in the laboratory. The low-power airborne system is suitable for day and night operations in quite good weather. It performs a real time detection of the oil, a mapping of the spill, and an identification of its thickest parts. A suitable Lidar

system can be composed by an XeCl excimer laser with small dimensions, a low energy consumption, and 50 mJ energy per pulse. The detection system does not require an optical multichannel analyzer, but it is possible to operate with only three interferential filters: one for Raman scattering signal, the others for fluorescence signals, which are sufficient to identify the oil class.

Author (ESA)

N86-18371# Institut Francais du Petrole, Rueil-Malmaison. Div. de Teledetection Marine.

OPERATIONAL REMOTE SENSING OF OIL SLICKS AT SEA BY MICROWAVE RADIOMETRY

A. WADSWORTH and P. PIAU / In ESA Proceedings of EARSeL/ESA Symposium on European Remote Sensing Opportunities: Systems, Sensors, and Applications p 127-130 Jun. 1985 refs

Avail: NTIS HC A12/MF A01

Active microwave radiometry for oil spill thickness and volume estimation in the seas around France are reviewed. The technical solutions and the integration into an operational system are considered. Operating limits and development possibilities are discussed.

Author (ESA)

N86-18372# Institut Francais du Petrole, Rueil-Malmaison.
SYNTHETIC APERTURE RADAR IMAGING OF THE SEA SURFACE DURING THE PROMESS EXPERIMENT

P. PIAU and L. GRAY (Canadian Center for Remote Sensing, Ottawa) / In ESA Proceedings of EARSeL/ESA Symposium on European Remote Sensing Opportunities: Systems, Sensors, and Applications p 131-138 Jun. 1985 refs

Avail: NTIS HC A12/MF A01

The PROMESS experiment carried out wind and wave measurements on the sea surface with radars operating in the C-band, as with the Active Microwave Instrument aboard ERS-1. A good range of wave heights (ranging from 1 to 7 m) and wind speeds were encountered. The SAR 580 performed measurements with different azimuth angles in C and X-bands simultaneously. Images were obtained from a digital processor and from an optical one. The two sets of images were processed with Fourier and speckle removal technics. The wave length and direction of the long waves is determined with good accuracy. One day featured two wave systems at the same time with different wave lengths and directions. The two systems are well separated and measured by the SAR. The shape of the equivalent monodirectional wave spectrum obtained is very close to the one measured by the waverider.

Author (ESA)

N86-18386# Science Research Council, Chilton (England). Rutherford Appleton Lab.

RELATIVE VERTICAL POSITIONING USING GROUND-LEVEL TRANSPONDERS WITH THE ERS-1 ALTIMETER

R. J. POWELL / In ESA Proceedings of EARSeL/ESA Symposium on European Remote Sensing Opportunities: Systems, Sensors, and Applications p 243-246 Jun. 1985 refs

Avail: NTIS HC A12/MF A01

A technique for using the ERS-1 altimeter to measure the relative vertical position of land-based transponders and the ocean geoid on 2000 km long segments of the satellite ground track is proposed. The absolute position accuracy is similar to that of the laser tracking stations, relative accuracy may be of the order of a few centimeters, and measurements of changes in transponder elevation during the 3 yr satellite life may be at the sub-centimeter level. The opportunity for such measurements is provided by exploiting together very accurate range measurements made to ground-based transponders and the demonstrated constancy of form of satellite short-arc orbits repeated over an identical ground track. Altimetric vertical position measurements of this accuracy make possible techniques for altimeter calibration, sea-state bias measurements, orbit measurement and seismic/geodetic study.

Author (ESA)

N86-18387# Mullard Space Science Lab., Dorking (England).

THE ERS-1 ALTIMETER TRACKER PERFORMANCE SIMULATION

C. G. RAPLEY, N. F. MCINTYRE, R. F. SCOTT, A. P. R. COOPER (Scott Polar Research Inst., Cambridge, England), E. NOVOTNY (Scott Polar Research Inst., Cambridge, England), A. R. BIRKS (Science Research Council, Chilton, England), and H. D. GRIFFITHS (Univ. Coll., London, England) / In ESA Proceedings of EARSeL/ESA Symposium on European Remote Sensing Opportunities: Systems, Sensors, and Applications p 247-251 Jun. 1985 refs

(Contract ESA-5684/83/NL-BI)

Avail: NTIS HC A12/MF A01

An Altimeter Performance Simulator (APS) which permits the generation of simulated sequences of echo waveforms, and models the response of a radar altimeter tracker to them is presented. Results for the ERS-1 oceans mode tracking analytic waveforms representative of returns from the open ocean and sea ice, and its response to echo sequences synthesis are shown. Extensions of the APS include the addition of the ERS-1 ice tracking mode and the development of models representing coastal regions, land, and transitions from one surface type to another.

Author (ESA)

N86-18939# Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics.

ACTIVE AND PASSIVE REMOTE SENSING OF ICE Semiannual Progress Report, 1 Feb. - 31 Jul. 1985

J. A. KONG Jul. 1985 8 p

(Contract N00014-83-K-0258)

(AD-A160075) Avail: NTIS HC A02/MF A01 CSCL 08L

During this period we have: (1) developed a two-layer anisotropic random medium model to exploit the anisotropic effect of sea ice for active and passive microwave remote sensing, (2) used the Feynman diagrammatic technique in selectively summing and infinite perturbation series to include multiple scattering effects due to secularities that occur in the series for long-distance propagation, (3) extended the study of the two-layer anisotropic random medium model to a layer of isotropic random medium on top of a layer of anisotropic random medium in order to simulate the snow-covered ice fields for active microwave remote sensing, (4) used the strong fluctuation theory and the fluctuation-dissipation theorem to calculate the brightness temperature from a bounded layer of random discrete scatters with the zeroth and first order approximations, and (5) participated in the microwave sea ice measurement program at the Cold Regions Research and Engineering Laboratory (CRREL) in New Hampshire.

Author (GRA)

N86-18940# Computer Genetics Corp., Wakefield, Mass.

RAMAN BACKSCATTERING TECHNIQUE FOR THE REMOTE MEASUREMENT OF SUBSURFACE TEMPERATURE AND SALINITY. VOLUME 1: REVIEW

B. CAPUTO and D. A. LEONARD Dec. 1984 29 p

(Contract N00014-81-C-0725)

(AD-A160095) Avail: NTIS HC A03/MF A01 CSCL 08J

This report describes the current status of research on the laser Raman technique for the remote sensing of subsurface ocean temperature and salinity. It summarizes the state of the art as it relates to current Navy requirements, showing what it can be used for now, and what further work is required to develop the technique to its full potential. Volume 1, this document provides a management summary of the research program carried out by the contractor. Ships, aircraft and satellites provide alternative and complementary strategies for measuring the parameters of the marine environment. Subsurface temperature and salinity data obtained from ships and aircraft can be relatively comprehensive and accurate, but it is discrete and separated in time and space. The aim of the current research is to develop the capability to provide ships and aircraft with cost effective remote sensing instrumentation that can provide accurate and continuous subsurface temperature and salinity coverage. The spatial frequencies that would be available, on a quasi-synoptic basis (especially from aircraft), would significantly overlap with those

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available from satellite observations of the sea surface, thus enabling comparisons and allowing predictive statements to be developed. GRA

N86-18943# Naval Postgraduate School, Monterey, Calif.
OPTOMA (OCEAN PREDICTION THROUGH OBSERVATIONS, MODELING AND ANALYSIS) PROGRAM INTERIM REPORT: THE AIRBORNE OCEAN THERMAL STRUCTURE MAPPING PROJECT Report, for Feb. 1983 - Feb. 1985
M. C. COLTON and C. N. K. MOOERS Aug. 1985 106 p
(AD-A160283; NPS68-85-008) Avail: NTIS HC A06/MF A01 CSCL 08J

The Ocean Prediction Through Observation, Modeling and Analysis (OPTOMA) Program goals are to develop an ocean descriptive predictive system for studying and forecasting the evolution of ocean mesoscale features and the California Current System. Attainment of these goals requires the establishment of a broad-base ocean observing and monitoring system that includes, hydrographic research cruises, moored arrays, and remotely sensed data, etc. To forecast the evolution of the oceanic flow field, the observing system must include a means of obtaining real-time, synoptic maps for the initialization and verification of the dynamic model(s) used. P3 flights to deploy airborne expendable bathythermographs are a clear choice for frequent mappings. Since Feb., 1983 six OPTOMA missions have been flown. A total of 325 AXBTs have been successfully deployed off the northern and central California coasts. Data analysis reinforce recent discoveries about the character of the California Current System: the current regime is highly variable in nature and is comprised of cool anomalies, mesoscale eddies, 'squirts' and jets, current filaments and fronts. An airborne digital data acquisition system, built around an HP9816 microprocessor and a Sippican MK9 digitizing unit, digitizes the AXBT audio signal, then stores the profiles on diskette. GRA

N86-18945# Computer Genetics Corp., Wakefield, Mass.
REVIEW OF THE RAMAN BACKSCATTERING TECHNIQUE FOR THE REMOTE MEASUREMENT OF SUBSURFACE TEMPERATURE AND SALINITY: VOLUME 1 Summary Report
B. CAPUTO and D. A. LEONARD Dec. 1984 29 p
(Contract N00014-81-C-0725)
(AD-A160466) Avail: NTIS HC A03/MF A01 CSCL 17E

This document is a summary report which describes the current status of research on the laser Raman technique for the remote sensing of subsurface ocean temperature and salinity. The report, in three volumes, summarizes the state of the art as it relates to current Navy requirements, showing what it can be used for now, and what further work is required to develop the technique to its full potential. This document provides a management summary of the research program carried out by Computer Genetics Corporation over a number of years with support provided by several Government agencies including ONR, NRL, NASA and NOAA. The aim of current research is to develop the capability to provide ships and aircraft with cost effective remote sensing instrumentation that can provide accurate and continuous subsurface temperature and salinity coverage. The spatial frequencies that would be available, on a quasi-synoptic basis (especially from aircraft), would significantly overlap with those available from satellite observations of the sea surface, thus enabling comparisons and allowing predictive statements to be developed. The work to date has shown, by means of theoretical calculations, laboratory experiments, and field studies, that polarization Raman spectroscopy is feasible for the remote sensing of ocean temperature to a few tenths of a degree to depths of 50 to 100 meters in the open ocean. GRA

N86-18946# Naval Research Lab., Washington, D. C.
A SEMIEMPIRICAL MODEL FOR DOPPLER SPECTRAL FEATURES OF MICROWAVE RADAR SEA SCATTER Interim Report, Jun. - Oct. 1984
D. B. TRIZNA 16 Oct. 1985 32 p
(AD-A160576; NRL-8911) Avail: NTIS HC A03/MF A01 CSCL 17I

A semiempirical, fetch-dependent model is developed for Doppler spectral features of low grazing angle microwave radar sea scatter and is fit to data previously published in the literature. The model introduces this fetch dependence to account for the scatter in plots of the shift of the peak of the radar sea scatter Doppler spectrum data vs measured wind and surface parameters. First, constants for the model are determined by empirically curve fitting generalized versions of J. Darbyshire's fetch model equations to surface truth data (wind speed, wave height, and wave period), plotted in various combinations against one another, for 24 different experimental conditions. These constants are then applied to equations representing the Doppler shift of the peak of the sea scatter spectrum in terms of the surface truth data. Curves parametric in fetch, which are determined from these equations, are then superimposed over plots of the measured radar Doppler peak shifts vs the surface truth. It is found that these curves lie near the same groups of points in these plots of radar data vs surface truth, as the modified Darbyshire curves did for surface truth sets against one another. GRA

N86-19677# European Space Agency, Paris (France).
THE USE OF SATELLITE DATA IN CLIMATE MODELS
J. J. HUNT, comp. Sep. 1985 215 p refs Conference held in Alpbach, Austria, 10-12 Jun. 1985; sponsored by Austrian Solar and Space Agency, ESA, Bundesministerium fuer Forschung und Technologie, Commission of European Communities, European Science Foundation and World Climate Research Program (ESA-SP-244; ISSN-0379-6566) Avail: NTIS HC A10/MF A01

The use of satellites for remote sensing of ocean waves, ocean circulation, sea level, sea ice, ice and snow and sea surface temperature, was discussed. The ESA ERS-1 program and its national data centers were described.

N86-19678# Massachusetts Inst. of Tech., Cambridge.
IMPACT OF SATELLITE MEASUREMENTS ON OCEANOGRAPHIC COMPONENT OF THE WCRP
C. WUNSCH /In ESA The Use of Satellite Data in Climate Models p 3-6 Sep. 1985 refs
Avail: NTIS HC A10/MF A01

The use of satellite scatterometry, altimetry, gravity, and IR/microwave thermometry data in oceanography is discussed. The satellite needs of the Tropical Ocean-Global Atmosphere program and the World Ocean Circulation Experiment are reviewed. Accuracy, precision, sampling, and coverage requirements on satellite systems are considered. Author (ESA)

N86-19680# Royal Netherlands Meteorological Inst., De Bilt.
INTRODUCTION TO WAVE MODELS AND ASSIMILATION OF SATELLITE DATA IN WAVE MODELS
G. J. KOMEN /In ESA The Use of Satellite Data in Climate Models p 21-25 Sep. 1985 refs
Avail: NTIS HC A10/MF A01

Knowledge of the development of wind driven ocean waves, and wave models are discussed. The models integrate the energy transfer equations for the two dimensional wave spectrum numerically in time. The solution depends on external wind fields, specified in advance. Main applications are for ship routing, off-shore activities, and coastal defense. Validation of real-time model forecast results indicates the need for improvement of model results and wind input. Very little experience exists with the assimilation of wave observations into initial fields. A hindcast indicates that the effects of inaccuracies in the specified wind fields can be compensated by assimilation of observed wave parameters. Author (ESA)

N86-19681# Meteorological Office, Bracknell (England).

ALGORITHMS FOR WIND SCATTEROMETER PROCESSING

D. OFFILER *In* ESA The Use of Satellite Data in Climate Models p 27-31 Sep. 1985 refs

Avail: NTIS HC A10/MF A01

The measurement of surface wind speed and direction over the ocean, using scatterometry is introduced. The theoretical and experimental background to the technique and how this translates into practical instruments is outlined. The algorithms used to retrieve the wind vectors are described. Algorithms for the ERS-1 mission are broadly similar to those previously used for the SEASAT SASS instrument. Author (ESA)

N86-19682# Hochschule der Bundeswehr, Munich (West Germany).

ALGORITHM FOR WIND SCATTEROMETER DATA ANALYSIS-AMBIGUITY SUPPRESSION

K. J. SCHWENZFEGGER *In* ESA The Use of Satellite Data in Climate Models p 35-36 Sep. 1985 refs

Avail: NTIS HC A10/MF A01

An algorithm for retrieving the wind vectors of the bias corrected backscatter coefficients derived from simulated ERS-1 wind scatterometer measurements is described. The main task is wind vector estimation by fitting the beam ordered sigma zeros onto the ESA C-band model using a Bayesian type estimator (BE). Extremizing BE gives up to four wind vectors for each cell of the swath. The goodness of fit gives a ranking of solutions. The results of case studies show that nearly 100% of the rank 1 solutions are the correct wind vectors, so no additional postprocessing is necessary. Author (ESA)

N86-19683# Bremen Univ., (West Germany). Fachbereich 1.

MICROWAVE MEASUREMENTS OF THE SEA SURFACE

W. ALPERS *In* ESA The Use of Satellite Data in Climate Models p 41-45 Sep. 1985 refs

Avail: NTIS HC A10/MF A01

Interpretation of ERS-1 Active Microwave Instrument (AMI) data in terms of oceanographic parameters is discussed. In order to extract quantitative information from the SAR image, the C-band modulation transfer function (MTF) was calculated, using data from a modulation experiment in the North Sea. Imaging of large scale oceanic features is considered. Author (ESA)

N86-19684# Max-Planck-Inst. fuer Meteorologie, Hamburg (West Germany).

ASSIMILATION OF MICROWAVE DATA IN ATMOSPHERIC AND WAVE MODELS

K. HASSELMANN *In* ESA The Use of Satellite Data in Climate Models p 47-52 Sep. 1985 refs

Avail: NTIS HC A10/MF A01

Use of ERS-1, N-ROSS, TOPEX, and MOS-2 satellite data on global sea surface topography, surface winds, ocean waves, and sea ice for climate research and weather and wave forecasting is discussed. The need for an end-to-end data processing and assimilation system, including algorithms, dynamic data assimilation methods, and high resolution models, in order to produce the basic global data sets required for climate research is considered. It is shown that the data processing needs for climate studies are essentially the same as the processing needs for forecasting applications, so that the same system can satisfy both purposes. The relation of this end-to-end system, designed for the quasi-real time generation of level 3 gridded wind and wave fields, with other components of the ground segment, such as the generation of fast delivery products or the primary archiving facilities, is treated. Author (ESA)

N86-19685# Kiel Univ. (West Germany).

INTRODUCTION TO OCEAN CIRCULATION MODELS

J. WILLEBRAND *In* ESA The Use of Satellite Data in Climate Models p 63-64 Sep. 1985 refs

Avail: NTIS HC A10/MF A01

Prognostic and diagnostic ocean models are reviewed, and their equations of motion, including primitive equation and

geostrophic models are discussed. Circulation models can reproduce the wind-driven subtropical gyres, and the equatorial circulation system including its variations on time scales up to a few years. The effect of quasi-geostrophic eddies is fairly well simulated. On longer time scales, the situation is less satisfactory with respect to thermohaline processes. It seems likely that this situation will improve by 1990 when several satellites are expected to be in operation. A considerable effort, however, is needed for the development of circulation models that can assimilate wind and altimeter data on a global basis. Author (ESA)

N86-19686# Meteorological Office, Bracknell (England). Dynamical Climatology Branch.

COMMENTS ON DATA REQUIREMENTS FOR OCEAN CLIMATE STUDIES

H. CATTLE *In* ESA The Use of Satellite Data in Climate Models p 67-69 Sep. 1985 refs

Avail: NTIS HC A10/MF A01

The requirements for carrying out noninteractive integrations of ocean (and sea ice) models are discussed. Such integrations require forcing data to be specified from a knowledge of atmospheric parameters and the sea surface temperature and ice characteristics. In such integrations, the momentum flux is often specified directly via the vector surface stress fields (expressed in the main as monthly means. To determine the heat exchange across the interface, it is appropriate to specify the incoming radiative fluxes together with the air temperature, humidity, wind speed, and surface pressure from which the outgoing radiative fluxes and turbulent, sensible, and latent heat exchanges can be derived using the model predicted sea surface temperature and sea ice characteristics. The use of scatterometers and satellites, particularly for data-sparse areas of the Southern Hemisphere is discussed. Author (ESA)

N86-19687# Paris VI Univ. (France). Lab. de Physique et Chimie de l'Hydrosphere.

ANALYSIS AND INTERPRETATION OF ALTIMETRY DATA

J. F. MINSTER *In* ESA The Use of Satellite Data in Climate Models p 71-72 Sep. 1985 refs

Avail: NTIS HC A10/MF A01

Ways to extract the variability signal on the mesoscale and large scale from satellite altimetry studies of ocean dynamics are reviewed. Methods include comparison of the variability of signals along a repetitive track with the dynamic topography of the area; analysis of the residuals of the altimetric measurement at crossovers of ascending and descending tracks, after adjustment of the latter to minimize orbit errors; and use of the distance of individual track measurements to a reference mean sea surface. By using a large set of short crossover-adjusted arcs, it is possible to map larger than mesoscale variability. Author (ESA)

N86-19688# Imperial Coll. of Science and Technology, London (England). Atmospheric Physics Group.

ALTIMETRIC OBSERVING SYSTEM SIMULATION STUDIES WITH AN EDDY RESOLVING OCEAN CIRCULATION MODEL

J. MARSHALL *In* ESA The Use of Satellite Data in Climate Models p 73-76 Sep. 1985 refs

Avail: NTIS HC A10/MF A01

Synoptic mapping of geostrophic eddies from altimetry by assimilation into a quasi-geostrophic ocean model is discussed. It is shown that for synoptic mapping the accuracy of the analysis is limited by the finite temporal and spatial resolution possible with one satellite, rather than the random error in the instrument. There is a clear advantage in flying several moderately accurate altimeters rather than one very precise instrument. The importance of ensuring that altimetric missions are synchronized so that more than one altimeter is flying simultaneously is stressed. Author (ESA)

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N86-19689# Utrecht State Univ. (Netherlands). Inst. of Meteorology and Oceanography.

SEA LEVEL AND CLIMATE VARIATIONS

J. OERLEMANS /In ESA The Use of Satellite Data in Climate Models p 81-85 Sep. 1985 refs

Avail: NTIS HC A10/MF A01

Factors governing sea level and the relation between sea level and carbon dioxide are reviewed. The use of satellite data to study global variations in sea level is discussed. The greenhouse effect on the polar ice sheets, and consequences for sea level, are assessed. It is concluded that data are insufficient to make predictions other than that global temperature will increase.

Author (ESA)

N86-19690# Max-Planck-Inst. fuer Meteorologie, Hamburg (West Germany).

SEA ICE MODELS AND REMOTE SENSING

W. D. HIBLER /In ESA The Use of Satellite Data in Climate Models p 87-94 Sep. 1985 refs Sponsored by Office of Naval Research and Max-Planck Institute fuer Meteorologie, Hamburg

Avail: NTIS HC A10/MF A01

Sea ice modeling and how satellite remote sensing can be used in model verification, improvement, and applications are discussed. Ice dynamics, including the relevance of ice drift and deformation to climate are considered. The role and justification for the use of nonlinear plastic rheologies is described. In order to show the necessity for ice-ice interaction in coupled dynamic-thermodynamic simulations, seasonal Arctic simulation results using only free drift are compared to those using a plastic rheology. Results without ice interaction yield a totally unacceptable ice build-up, even after only a 1 yr integration. Ice edge variation and coupled ice ocean models are mentioned.

Author (ESA)

N86-19691# Institute of Oceanographic Sciences, Birkenhead (England).

ACCURACY OF EXISTING OCEAN TIDE MODELS

P. L. WOODWORTH /In ESA The Use of Satellite Data in Climate Models p 95-98 Sep. 1985 refs

Avail: NTIS HC A10/MF A01

The Schwiderski (1983) and Parke-Hendershott (1980) ocean tide models are assessed. The Schwiderski model is claimed to be capable of computing the instantaneous M2 partial ocean tide with an accuracy of 5cm or better at any time and anywhere in the open ocean although with certain reservations for coastal and border seas. Pelagic data show this claim to be optimistic. Similar model claims are made for the other tidal constituents resulting in a predicted combined tide accuracy of 10cm. Until copious altimeter data become available there is no real way, other than by additional tide gage measurements, of checking them. The Parke-Hendershott model is of comparable accuracy and is subject to similar difficulties of validation on a global basis.

Author (ESA)

N86-19692# Technical Univ. of Denmark, Lyngby.

APPLICATION OF SAR AND OTHER REMOTE SENSING DATA IN STUDIES OF THE ATMOSPHERE-OCEAN-ICE INTERACTION

P. GUDMANDSEN /In ESA The Use of Satellite Data in Climate Models p 107-111 Sep. 1985 refs

Avail: NTIS HC A10/MF A01

The physics of the atmosphere-ocean-ice interaction, the processes of the formation of sea ice and its characteristics from a remote sensing point of view, and the relevant remote sensing methods are reviewed. Use of the ERS-1 Active Microwave Instrument in the Arctic and Antarctic is discussed. The need for preparatory observation and modeling research to fully exploit satellite capabilities is stressed.

Author (ESA)

N86-19693# National Museum of Natural History, Paris (France). Lab. d'Océanographie Physique.

SCIENTIFIC APPLICATION OF SAR DATA TO SEA ICE STUDIES. SEA ICE MODELS

J. C. GASCARD /In ESA The Use of Satellite Data in Climate Models p 113-114 Sep. 1985

Avail: NTIS HC A10/MF A01

Sea ice observations from space are discussed and SAR contributions to sea ice numerical modeling are assessed. Satellite observations of sea ice concentrations in two dimensions help considerably in tuning models for a better prediction of ice thickness and for sea ice mass balance estimations.

Author (ESA)

N86-19694# Atmospheric Environment Service, Ottawa (Ontario).

SCIENTIFIC APPLICATION OF PASSIVE MICROWAVE SATELLITE DATA FOR ICE MONITORING AND RESEARCH

I. G. RUBINSTEIN (Ph.D. Associates, North York, Ontario) and R. O. RAMSEIER /In ESA The Use of Satellite Data in Climate Models p 117-123 Sep. 1985 refs

Avail: NTIS HC A10/MF A01

Algorithms for determination of total sea ice concentrations and ice type identification were tested during near real-time operational production of sea ice charts for the Arctic, Canadian East Coast, and the East Greenland Sea regions. Using computer contouring techniques, the sea ice parameters were determined with a spatial location accuracy within one half of a 37 GHz footprint (15 km). Model calculated total ice concentrations are in close agreement with values measured by the airborne sensors (10% deviation). In areas where gray and very young ice are present, the total ice concentrations are underestimated by 50%. The near real-time operational testing of the algorithm derived ice and wind charts provides very valuable information for improvement of the existing sea ice algorithms. The all weather capabilities of the spaceborne passive microwave sensors are positively established.

Author (ESA)

N86-19695# Science Research Council, Chilton (England). Rutherford Appleton Lab.

FUTURE PASSIVE MICROWAVE SATELLITE DATA FOR SEA-ICE RESEARCH

D. L. CROOM /In ESA The Use of Satellite Data in Climate Models p 125-127 Sep. 1985 refs

Avail: NTIS HC A10/MF A01

The potential of the passive microwave radiometers which form part of the Along Track Scanning Radiometer (ATSR) to be flown on ERS-1, and the Advanced Microwave Sounding Unit (AMSU) to be flown on the NOAA-TIROS series, for studies of sea-ice is surveyed. The ATSR will carry limited, but useful passive microwave channels for sea-ice studies, especially for assessing the value of altimetry over sea-ice. The AMSU-B will be a source of extensive sea-ice data and will provide it over a long (20yr plus) time scale. The AMSU-B should also be considered as a potential valuable source of data for land snow-cover.

Author (ESA)

N86-19698# Science Research Council, Chilton (England). Rutherford Appleton Lab.

PRECISE SST DATA FROM SATELLITES

D. T. LLEWELLYN-JONES /In ESA The Use of Satellite Data in Climate Models p 139-142 Sep. 1985

Avail: NTIS HC A10/MF A01

The importance of ocean skin temperatures, in contrast to bulk temperatures, in climate models using sea surface temperatures measured by the ERS-1 Along Track Scanning Radiometer (ATSR) is pointed out. The ATSR accuracy is expected to reach 0.3 K, i.e., a factor of 2 better than AVHRR, and modellers who require bulk temperatures should say so, as this affects data products and their treatment.

Author (ESA)

05 OCEANOGRAPHY AND MARINE RESOURCES

N86-19699# Istituto di Fisica dell'Atmosfera, Rome (Italy).

REMOTE SENSING OF SEA SURFACE TEMPERATURE

G. DALU and A. VIOLA *In* ESA The Use of Satellite Data in Climate Models p 143-145 Sep. 1985 refs Sponsored by CNR

Avail: NTIS HC A10/MF A01

The methodology that lies behind the algorithms used to retrieve the sea surface temperature from infrared radiometric data is examined with a radiative transfer model, that simulates the response of the atmosphere for different temperature and water vapor profiles. Generally linear algorithms are used to evaluate the sea surface temperature from the AVHRR data. Although the results obtained show that a nonlinear algorithm is more accurate, a linear algorithm can give better results if it is optimized for a particular region and season. Results show that the algorithms found in the literature are appropriate to particular data sets, and no single algorithm can be applied to other samples if they are from a completely different area or a different season.

Author (ESA)

N86-19700# Mullard Space Science Lab., Dorking (England).

POST LAUNCH CALIBRATION AND VALIDATION OF THE ALONG TRACK SCANNING RADIOMETER (ATSR)

I. M. MASON *In* ESA The Use of Satellite Data in Climate Models p 149-150 Sep. 1985 refs

Avail: NTIS HC A10/MF A01

On-board calibration and validation of the ERS-1 Along Track Scanning Radiometer (ATSR), used for sea surface temperature (SST) measurement, are discussed. It is important that on-board calibration and validation are carried out to a precision compatible with the lowest expected atmospheric noise (0.1K RMS). The skin SST should ideally be the validated ATSR product, for reasons of accuracy and because of the role of skin SST in the ocean/atmosphere heat exchange. If possible, each algorithm should be validated separately, using a variety of instruments and sites. To retain the ATSR levels of precision, any correction of algorithms using validation data should be done by modeling the physical processes giving rise to the algorithm errors. An improved understanding and modeling of the skin/bulk SST differences will allow the validation of ATSR using bulk SST and aid the incorporation of ATSR data in climate models.

Author (ESA)

N86-19701# Oxford Univ. (England). Dept. of Atmospheric Physics.

FOUR-DIMENSIONAL DATA ASSIMILATION IN TOGA MODELS

D. L. T. ANDERSON and A. M. MOORE *In* ESA The Use of Satellite Data in Climate Models p 151-153 Sep. 1985 refs

Avail: NTIS HC A10/MF A01

Use of ocean surface stress and heat fluxes in Tropical Ocean Global Atmosphere program models is discussed. Since the forcing fields are perfectly known and the ocean is not totally deterministic, redundancy must be built in. Measurements give mass field information, and numerical models indicate that this data may be very useful. The models do not reject height field data. Altimeter data could be very useful for interpolating between tide gage networks. Altimeter data can also be assimilated into models. The best method of projecting this data onto the vertical model structure uses XBT data. Sea surface temperatures (SST) used with XBT data may be very useful. Altimetry and SST can be used for model verification even if they are not used for assimilation.

Author (ESA)

N86-19702# Science Research Council, Chilton (England). Rutherford Appleton Lab.

THE USE OF AIRBORNE MICROWAVE INSTRUMENTS TO GATHER DATA FOR THE VALIDATION OF ERS-1 WIND AND WAVE PRODUCTS

R. J. POWELL *In* ESA The Use of Satellite Data in Climate Models p 155-156 Sep. 1985 refs

Avail: NTIS HC A10/MF A01

It is suggested that the main European effort to validate the wind and wave data products of ERS-1 should be concentrated

in the Northeast Atlantic and Norwegian Sea. Conventional oceanographic data gathering techniques using ships and buoys should be augmented with permanently deployed and well-validated master stations and airborne instrumentation. The need to site such stations and altimeter transponders on the ground track argues strongly for the early selection of the location of 3 day repeat ground tracks and for ensuring that any higher repeat cycle used later is a multiple of 3.

Author (ESA)

N86-19703# Institute of Oceanographic Sciences, Wormley (England).

WINDS FOR CLIMATE RESEARCH FROM THE ERS-1 AND N-ROSS SCATTEROMETERS

T. H. GUYMER *In* ESA The Use of Satellite Data in Climate Models p 157-159 Sep. 1985 refs

Avail: NTIS HC A10/MF A01

Requirements for sea-surface wind in climate research are discussed in terms of accuracy and sampling considerations. Very stringent accuracies are needed and it is particularly important that biases in areal and temporal mean winds be minimized. These may arise from geographical biases in algorithms tuned to limited comparison data sets and from atmospheric attenuation effects. A single satellite scatterometer is incapable of providing adequate sampling and it is envisaged that the surface wind fields will be obtained from a combination of ERS-1, N-ROSS and in-situ data, including those of the Voluntary Observing Ships.

Author (ESA)

N86-19704# European Space Agency, Paris (France).

REVIEW OF SCIENTIFIC AND TECHNICAL WORK REQUIRED BEFORE THE LAUNCH OF ERS-1: THE VIEW OF ESA

G. DUCHOSSOIS, J. LOUET (ESA/ESTEC, Noordwijk, Netherlands), C. R. FRANCIS (ESA/ESTEC, Noordwijk, Netherlands), and E. ATTEMA (ESA/ESTEC, Noordwijk, Netherlands) *In its* The Use of Satellite Data in Climate Models p 163-173 Sep. 1985

Avail: NTIS HC A10/MF A01

The ESA views and plans for the utilization of ERS-1 data, sensor calibration and data validation, and activities for the coordination/cooperation with entities interested in ERS-1 and/or having similar programs under preparation are summarized. The ERS-1 will study coastal zones and global ocean processes which, together with the monitoring of polar regions, will provide a major contribution to the World Climate Research Program. It will establish, develop, and exploit coastal, ocean, and ice applications of remote sensing data. These applications are related mainly to a better knowledge of ocean and ice parameters and sea-state conditions. The Active Microwave Instrument and radar altimeter are presented.

Author (ESA)

N86-19706# Mullard Space Science Lab., Dorking (England).

THE UK ERS DATA CENTRE

C. G. RAPLEY *In* ESA The Use of Satellite Data in Climate Models p 177-179 Sep. 1985

Avail: NTIS HC A10/MF A01

The data facility to be built by the UK as part of its ERS-1 program and a measure taken within that facility to alleviate the problem of inadequate access to hardware and data sets are described. The main functions of the center are data receipt and archive; algorithm development; off-line product generation; product validation/quality monitoring; customer services; and dispatch.

Author (ESA)

N86-19707# Centre National d'Etudes Spatiales, Paris (France). Earth Sciences and Applications Div.

THE CERSAT/AVISO/ALGOS: THE FRENCH PROGRAM FOR A COHERENT OCEANOGRAPHIC DATA BASE

B. NUTTEN *In* ESA The Use of Satellite Data in Climate Models p 181-183 Sep. 1985 refs

Avail: NTIS HC A10/MF A01

The French national plan for data handling of ERS-1 and future space oceanographic missions is presented. It is based on two data centers and one group. The CERSAT is the ERS-1 off-line low bit rate data center, part of the four-component preprocessing

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and archiving facilities managed by the Earthnet Program Office, aimed at production of geophysical data. The AVISO is a multisatellite data center for archiving geophysical oceanographic data, and processing of value-added products. The purpose of the ALGOS group, coordinated by scientists and engineers, is the development of models and algorithms required by the Data Centers. Author (ESA)

N86-19812# Science Applications International Corp., La Jolla, Calif.

INTEGRATED REPORT ON MECHANISMS RESPONSIBLE FOR NARROW ANGLE V-WAKES IN THE GEORGIA STRAIT EXPERIMENT Final Report

E. D. BROWN Jun. 1985 30 p

(Contract N00014-83-C-0438)

(AD-A159892) Avail: NTIS HC A03/MF A01 CSCL 20D

The Georgia Strait Experiment was designed to identify the mechanisms responsible for SAR imaging of narrow angle v-wakes. SAR overflights were coordinated with surface measurements of environmental conditions and of wave height and slope within a ship wake. Narrow v-wakes were observed by and L-band aircraft SAR with incidence angles of 20 - 50 deg, under low ambient wind conditions for all relative orientations between the SAR and ship tracks. These V-lines are a few pixels wide (approx 10 m), several kilometers in length, and approx. 17 dB above the background radar backscatter at a distance of 1 km behind the ship. Surface measurements and modeling analysis from this experiment demonstrate that these v-wakes are unrelated to ship-generated internal wave wakes. The qualitative features of L-band v-wakes are consistent with first order Bragg scattering from intermittently generated ship surface waves. This report reviews the theoretical basis and the experimental evidence supporting this mechanism. GRA

N86-19814# Naval Polar Oceanography Center, Washington, D.C.

ANTARCTIC ICE CHARTS, 1983-1984

Sep. 1985 215 p

(AD-A159907; RR-6) Avail: NTIS HC A10/MF A01 CSCL 08L

This publication is the sixth in a continuing bi-yearly series of Antarctic sea ice atlases prepared in the Joint Ice Center at the Naval Polar Oceanography Center, Suitland. The Atlas contains weekly charts depicting Southern Hemisphere ice conditions and extents. The information presented was prepared under operational time constraints principally from satellite imagery supplemented by conventional observations. Table 1, located on the inside back cover, summarizes satellite data availability for 1983 and 1984. GRA

N86-19822# Naval Postgraduate School, Monterey, Calif.

DETECTION OF SHOALS IN SEASAT SYNTHETIC APERTURE RADAR IMAGERY: SELECTED CASE STUDIES M.S. Thesis

R. L. DICKERMAN Sep. 1985 142 p

(AD-A161181) Avail: NTIS HC A07/MF A01 CSCL 08J

Ocean-going vessels have increased in size and draft in recent years, making traditional waterways too shallow and dangerous for use, and new shipping methods and increased costs require shorter transit times. Therefore, as new shipping routes are being sought, limited hydrographic survey resources must be efficiently applied. This study sought to demonstrate the feasibility of synthetic aperture radar (SAR) imagery as a tool for hydrographic presurvey planning by analyzing SAR imagery of Shelikof Strait, Alaska. Anomalous brightness patterns visible in SAR imagery were related to interactions between ocean phenomena and bathymetric features, and an analysis of wave refraction was performed using optical Fourier transform (OFT)-measured wave spectra. The study results showed surface gravity wave refraction as measured by OFT's can be used to make quantitative estimates of water depths, generally within 40% error. Also, anomalous brightness patterns visible in SAR imagery indicate possible hazards to navigation. However, the absence of an anomalous pattern does not mean a hazard is not present. Author (GRA)

N86-20261# Joint Publications Research Service, Arlington, Va. **AEROSPACE OBSERVATIONS OF ADVECTIVE-EDDY FORMATIONS IN CENTRAL BALTIC SEA Abstract Only**

I. A. BYCHKOVA, S. V. VIKTOROV, V. V. VINOGRADOV, V. N. LOSINSKIY, and K. Y. BROSIN *In its* USSR Report: Space (JPRS-USP-86-001) p 156 13 Jan. 1986 Transl. into ENGLISH from Issledovaniye Zemli iz Kosmosa (Moscow, USSR), no. 1, Jan. - Feb. 1985 p 118-122 Original language document was announced in IAA as A85-29915

Avail: NTIS HC A03

Under definite conditions eddy movements occurring at different depths in the Baltic Sea can be manifested in the form of surface nonuniformities of the temperature field and brightness of the sea surface. These nonuniformities are registered by satellite instruments operating in the visible and IR ranges. Considering the role of the wind in dynamic processes in the Baltic, there is probably a high frequency of recurrence of formation of local advective-eddy fronts of synoptic scales in the surface layer. Study of such phenomena was the objective of the second USSR-GDR Complex Subsatellite Experiment. The research ship A. von Humboldt during the first half of June 1983 was in a hydrological test range in the central part of the sea, each day occupying 8 to 9 stations. Satellite information in the IR range was received simultaneously. The observations revealed that regardless of wind conditions a correlation between radiation temperatures obtained from both a satellite and aircraft and shipboard thermodynamic temperatures can be traced to a depth of 17 m. At a depth of 35 to 40 m the correlation coefficient becomes negative, corresponding to the formation of a countercurrent in the Ekman layer. Accordingly, sea surface temperature maps obtained in the Baltic Sea using satellite data can be used in tracking drift currents. The three-dimensional thermal structure in the test range for 7 June on the basis satellite and ship is discussed. Author

N86-20267# Joint Publications Research Service, Arlington, Va. **POSSIBILITY OF USING SATELLITE IR-INFORMATION FOR OCEANOLOGICAL RESEARCH Abstract Only**

I. V. LIKHACHEV and A. N. MICHURIN *In its* USSR Report: Space (JPRS-USP-86-001) p 160-161 13 Jan. 1986 Transl. into ENGLISH from Vestnik Leningradskogo Universiteta: Geologiya, Geografiya (Leningrad, USSR), no. 14, issue 2, Jun. 1985 p 93-95

Avail: NTIS HC A03

Although there are real possibilities for obtaining satellite information (SI) for considerable expanses of the ocean, there are still no possibilities for its routine processing. This dictates a need for storing SI for its subsequent processing at on-shore computation centers. In exploring this problem, a Kapsi receiving station was used in determining the possibility of reception and registry of SI on an intermediate magnetic carrier with subsequent input of the SI into a computer. It was found that an ordinary magnetic recorder tape can be used as a magnetic carrier. An effective method was developed for SI registry on magnetic tape. On one track of an ordinary stereophonic recorder having adequately high frequency characteristics and relatively low detonation, there is registry of a satellite signal of a subcarrier frequency from the receiver output; the second track is used in registering a pulsed signal from a highly stable quartz oscillator used in data processing as a synchronizable signal determining the discreteness of SI digital readings. The next stage in data preparation is the input of satellite data registered on magnetic tape into a computer memory, with discrimination of R-radiometer data from the total volume of data. R.J.F.

N86-20448# Joint Publications Research Service, Arlington, Va.
OPTICAL THICKNESS OF ATMOSPHERIC AEROSOL OVER SEA
Abstract Only

K. S. SHIFRIN, V. M. VOLGIN, B. N. VOLKOV, O. A. YERSHOV, and A. V. SMIRNOV *In its* USSR Report: Space (JPRS-USP-86-002) p 65 10 Feb. 1986 Transl. into ENGLISH from Issledovaniye Zemli iz Kosmosa (Moscow, USSR), no. 4, Jul. - Aug. 1985 p 21-30 Original language document was announced in IAA as A86-13278
 Avail: NTIS HC A05

Measurements of the optical depth of the atmospheric aerosol over marine and coastal regions are presented. The measurements were carried out using a photoelectric amplifier and a photodiode detector having a combined sensitivity in the range 300-1016 nm. The measured data were cross correlated using the Burder method and the results are discussed. It is shown that the two sets of measurements have good correlation in the visible band (300-500 nm), and in the infrared (500-1016 nm). The estimated optical depths are given in a table. I.H.

N86-20678# National Aeronautics and Space Administration, Langley Research Center, Hampton, Va.
DEVELOPMENT OF UHF RADIOMETER
 B. M. KENDALL, H. J. C. BLUME, and A. E. CROSS Dec. 1985 58 p refs
 (NASA-TP-2504; L-16006; NAS 1.60:2504) Avail: NTIS HC A04/MF A01 CSCL 09A

A wideband multifrequency UHF radiometer was initially developed to operate in the 500 to 710 MHz frequency range for the remote measurement of ocean water salinity. However, radio-frequency interference required a reconfiguration to operate in the single-frequency radio astronomy band of 608 to 614 MHz. Details of the radiometer development and testing are described. Flight testing over variable terrain provided a performance comparison of the UHF radiometer with an L-band radiometer for remote sensing of geophysical parameters. Although theoretically more sensitive, the UHF radiometer was found to be less desirable in practice than the L-band radiometer. Author

N86-21096# Centre National d'Etudes Spatiales, Toulouse (France). Centre Spatial.
STUDY OF THE APPLICATIONS OF ALTIMETRY DATA AND EXTRACTION METHODS Final Report [ETUDE SUR LES APPLICATIONS DES DONNEES D'ALTIMETRIE ET METHODES D'EXTRACTION]

A. DELEFFE, M. AVIGNON, P. RAZONVILLE, G. CUVELIER, and Y. MENARD (Groupe de Recherches de Geodesie Spaciale, GRGS, Toulouse, France) 29 Jan. 1985 426 p refs In FRENCH (Contract ESA-5812/84/NL-PB(SC))
 (ESA-CR(P)-2113) Avail: NTIS HC A19/MF A01

The characteristics and utility of possible oceanographic and geophysics products are examined, referring to SEASAT results and to ERS-1 satellite possibilities. A global analysis of altimetric measurement errors is presented, estimating the amplitude and associated wavelength of the errors before and after correction. The main sources of error include instrument errors, for which a simulation computer program was developed in order to obtain quantitative estimations, errors due to ocean surface-electromagnetic interaction, propagation errors, and errors due to geophysical factors such as tides and atmospheric pressure. The algorithms used for SEASAT were studied, leading to data processing propositions for ERS-1. An external calibration strategy, using the laser site at Dakar, is also presented. Author (ESA)

N86-22024*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.

ASSESSING THE CAPABILITY OF EOS SENSORS IN MEASURING OCEAN-ATMOSPHERE MOISTURE EXCHANGE
 W. T. LIU 15 Dec. 1985 26 p refs
 (Contract NAS7-918)
 (NASA-CR-176658; JPL-PUB-85-93; NAS 1.26:176658) Avail: NTIS HC A03/MF A01 CSCL 04A

As part of the Science Synergism Studies to identify interdisciplinary Scientific studies, which could be addressed by the Environmental Observing System (EOS), the techniques being developed to measure ocean-atmosphere moisture exchanges using satellite sensors were evaluated. Studies required to use sensors proposed for EOS were examined. A method has been developed to compute the moisture flux using the wind speed, sea surface temperature, and precipitable water measured by satellite sensors. It relies on a statistical model which predicts surface-level humidity from precipitable water. The Scanning Multichannel Microwave Radiometer (SMMR) measures all 3 parameters and was found to be sensitive to the annual cycle and large interannual variations such as the 1982 to 1983 El Nino. There are systematic differences between geophysical parameters measured by Nimbus/SMMR and in situ measurements. After quadratic trends and crosstalks were removed from the parameters through multivariate regressions, the latent heat fluxes computed from SMMR agree with those computed from ship reports to within 30 W/sq m. The poor quality of ship reports may be the cause of a portion of this scatter. Similar results are found using SEASAT/SMMR data. When the scatterometer winds were used instead of the SMMR winds, the difference between the satellite fluxes and the ship fluxes was reduced. Author

N86-22075# Naval Ocean Research and Development Activity, Bay St. Louis, Miss.
CZCS (COASTAL ZONE COLOR SCANNER) ATLAS OF WATER OPTICAL PROPERTIES IN THE ALBORAN SEA Final Report
 R. ARNONE and R. ORIOL Aug. 1985 28 p
 (AD-A162503; NORDA-117) Avail: NTIS HC A03/MF A01 CSCL 08J

Optical water properties of the world oceans can be rapidly obtained from data from the Coastal Zone Color Scanner (CZCS) aboard the Nimbus -7 satellite. Satellite processing techniques have been developed to eliminate the atmospheric contamination that contributes 90% of the total visible channel signal. The remaining signal, which constituted the ocean color, is directly related to the diffuse attenuation coefficient (k) at 490 nanometers for the upper surface waters. Calculation and geographic registration of k can be done for each of the 800-square-meter pixel resolution of CZCS, and results show that the accuracy is within 25% of ship measurements. This report indicates the processing procedures used to calculate k from radiance data from the CZCS. GRA

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HYDROLOGY AND WATER MANAGEMENT

Includes snow cover and water runoff in rivers and glaciers, saline intrusion, drainage analysis, geomorphology of river basins, land uses, and estuarine studies.

A86-19501

SATELLITE-BASED ESTIMATORS OF HEAVY PRECIPITATION
 R. A. SCOFIELD (NOAA, Satellite Applications Laboratory, Washington, DC) IN: Recent advances in civil space remote sensing; Proceedings of the Meeting, Arlington, VA, May 3, 4, 1984. Bellingham, WA, SPIE - The International Society for Optical Engineering, 1984, p. 84-91. refs

The purpose of this paper is to present satellite-GOES based methodologies for analyzing and forecasting (short range)

precipitation from convective systems, extratropical cyclones and tropical cyclones. Currently, satellite-derived precipitation estimates and 3-hour precipitation trends for convective systems, extratropical cyclones and tropical cyclones are computed on the NESDIS Interactive Flash Flood Analyzer and transmitted via AFOS to Weather Service Forecast Offices, Weather Service Offices and River Forecast Centers. These estimates and trends aid hydrologists and meteorologists in their evaluation of heavy precipitation events. Author

A86-21152#**WATER QUALITY MONITORING OF LAKE BALATON USING LANDSAT MSS DATA**

H. SHIMODA, M. ETAYA, T. SAKATA (Tokai University, Tokyo, Japan), L. GODA, and K. STELCZER (Vizgazdalkodasi Tudomanyos Kutatokozpont, Budapest, Hungary) IN: International Symposium on Remote Sensing of Environment, 18th, Paris, France, October 1-5, 1984, Proceedings. Volume 1. Ann Arbor, MI, Environmental Research Institute of Michigan, 1985, p. 565-574.

Water quality monitoring of Lake Balaton, Hungary was studied using Landsat MSS data. Ground truth measurements were done simultaneously with the data acquisition of MSS data and fourteen items of water qualities were measured on the lake. After certain preprocessing of MSS data, linear multi regression analyses were made between MSS data and ground truth data. Nine items among the water qualities showed correlations to the MSS data, especially transparency, chlorophyll-a, UV extinction and oxygen saturation showed sufficient and strong correlations. These four kinds of water quality patterns were clearly extracted. Author

A86-21174#**SURFACE CURRENTS IN THE LONG POINT REGION AS DETERMINED FROM LANDSAT IMAGERY**

E. F. LEDREW and S. E. FRANKLIN (Waterloo, University, Canada) IN: International Symposium on Remote Sensing of Environment, 18th, Paris, France, October 1-5, 1984, Proceedings. Volume 2. Ann Arbor, MI, Environmental Research Institute of Michigan, 1985, p. 885-894. Research supported by the Board of Industrial Leadership and Development. refs (Contract NSERC-A-8454)

The surface currents of the Long Point region of Lake Erie have been mapped from Landsat imagery for eight cases. Current patterns are inferred from the configuration of sediment tendrils observed on enhanced and classified images. A 'coastal jet' is clearly evident along the south shore of Long Point for all weather patterns; when the intensity is not reduced by a north component in the regional air flow, an instability vortex develops to the east of the tip of Long Point. Within the Long Point Bay, a counterclockwise flow is observed that appears to be part of a gyre. Effluents released within this region could possibly become part of a closed circulation so the implications for the sensitive marshes of Turkey Point and Long Point must be considered. D.H.

A86-21195#**APPLICATION OF MULTISENSOR OBSERVATIONS TO GREAT LAKES HYDROLOGIC FORECAST MODELS**

R. L. GAUTHIER, R. A. MELLOH (U.S. Army, Corps of Engineers, Detroit, MI), T. E. CROLEY, II, and H. C. HARTMANN (NOAA, Great Lakes Environmental Research Laboratory, Ann Arbor, MI) IN: International Symposium on Remote Sensing of Environment, 18th, Paris, France, October 1-5, 1984, Proceedings. Volume 2. Ann Arbor, MI, Environmental Research Institute of Michigan, 1985, p. 1129-1140. refs

The Lake Superior Water Supply Study, a cooperative U.S. and Canadian pilot program for the total Great Lakes system is described. The study incorporates integrated, multilevel, and multisensor observations of hydrometeorologic conditions into the development of dedicated hydrologic forecast models for the lake. Results of periodic airborne gamma radiation snowpack measurements are presented, and plans for future airborne soil moisture surveys are discussed. The application of point, line, and areal observations to water supply forecast modeling for Lake

Superior is described. The Large Basin Runoff Model, extended to forecast water supplies to Lake Superior, is being tested and/or modified to incorporate remotely sensed data in the future. Expected results and future program directions for data collection and modeling are presented. D.H.

A86-21215#**SATELLITE MICROWAVE RADIOMETRY OF SNOW COVER**

M. HALLIKAINEN (Helsinki University of Technology, Espoo, Finland) IN: International Symposium on Remote Sensing of Environment, 18th, Paris, France, October 1-5, 1984, Proceedings. Volume 3. Ann Arbor, MI, Environmental Research Institute of Michigan, 1985, p. 1405-1414. refs

The major factors contributing to the brightness temperature of snow-covered terrain are discussed, including the dielectric and scattering properties of snow, the dielectric properties of soils, and the effect of surface types. The effect of various surface types (forests etc.) to the brightness temperature is determined experimentally. Opacity contributions from the water vapor, liquid water and oxygen in the atmosphere are reviewed briefly. An algorithm to retrieve the water equivalent of snow cover from 18 GHz and 37 GHz brightness temperature data is presented. Author

A86-21217*# Howard Univ., Washington, D. C.**EVALUATION OF THE SATELLITE DERIVED SNOW COVER AREA - RUNOFF FORECASTING MODELS FOR THE INACCESSIBLE BASINS OF WESTERN HIMALAYAS**

B. DEY (Howard University, Washington, DC) IN: International Symposium on Remote Sensing of Environment, 18th, Paris, France, October 1-5, 1984, Proceedings. Volume 3. Ann Arbor, MI, Environmental Research Institute of Michigan, 1985, p. 1425-1432. refs (Contract NAG5-224)

In this study, the existing seasonal snow cover area runoff forecasting models of the Indus, Kabul, Suttlej and Chenab basins were evaluated with the concurrent flow correlation model for the period 1975-79. In all the basins under study, correlation of concurrent flow model explained the variability in flow better than by the snow cover area runoff models. Actually, the concurrent flow correlation model explained more than 90 percent of the variability in the flow of these rivers. Compared to this model, the snow cover area runoff models explained less of the variability in flow. In the Himalayan river basins under study and at least for the period under observation, the concurrent flow correlation model provided a set of results with which to compare the estimates from the snow cover area runoff models. Author

A86-21240#**AIRBORNE MEASUREMENTS OF FRESHWATER ICE ALBEDOS**

G. A. LESHKEVICH (NOAA, Great Lakes Environmental Research Laboratory, Ann Arbor, MI) and N. J. REID (Monitek, Ltd., Concord, Canada) IN: International Symposium on Remote Sensing of Environment, 18th, Paris, France, October 1-5, 1984, Proceedings. Volume 3. Ann Arbor, MI, Environmental Research Institute of Michigan, 1985, p. 1677-1687. refs

The albedos of open water and four major freshwater ice types were measured under clear skies from an altitude of approximately 300 m, using a programmable band spectral radiometer onboard a U.S. Coast Guard helicopter. The instrument is capable of making simultaneous radiance and irradiance measurements in the visible and near-infrared range (400-1100 nm). The ice types (on southern Lake Huron, March 26, 27, 1984) included refrozen slush, densely consolidated brash, large floes in a black ice matrix, and skim ice. Irradiance measurements were made from ground level, between the airborne radiance measurements, so as to avoid possible attenuation due to the helicopter rotor blades. Radiance measurements were averaged for three passes and then machine processed with the irradiance data, to obtain reflectance values covering the wavelength range from 430 to 1100 nm for each surface type. D.H.

A86-21252#**EXTRACTION OF TOPOGRAPHIC NETWORKS FROM DIGITAL ELEVATION DATA**

L. E. BAND (Hunter College, New York) IN: International Symposium on Remote Sensing of Environment, 18th, Paris, France, October 1-5, 1984, Proceedings. Volume 3. Ann Arbor, MI, Environmental Research Institute of Michigan, 1985, p. 1795-1801. refs

Image processing techniques are used to extract and synthesize stream canyon networks from a digital elevation model of a set of mountainous watersheds. The methods involve a multi-step approach where pixels are first nominated to lie along a canyon based on local topography, and then successively grown and refined into coherent network structures. The resulting stream graphs may serve as the topological basis of a distributed hydrologic information system and is well suited for use in watershed runoff simulation. Author

A86-21257#**EFFECT OF ANTARCTIC ICE CRYSTALS AND AEROSOLS ON THE POLARIMETRY AND PHOTOMETRY OF THE ANTARCTIC SKY**

W. G. EGAN (Lamont-Doherty Geological Observatory, Palisades, NY) IN: International Symposium on Remote Sensing of Environment, 18th, Paris, France, October 1-5, 1984, Proceedings. Volume 3. Ann Arbor, MI, Environmental Research Institute of Michigan, 1985, p. 1845-1854. Navy-supported research. refs (Contract NSF 81-15231)

This paper represents a progress report on the applicability of the Dave spectral polarimetric and photometric atmospheric model to the Antarctic summer sky containing ice clouds. Although the model is based on plane parallel layers, it was found to be valid in predicting the photometry and polarimetry between 0.400 and 1.0 microns within a factor of approximately two. Additional observations were made at 0.36-micron and to 1.6-microns wavelengths. Radiosonde observations were used as supplementary input data for ice cloud location. The Mie scattering calculations assumed spheres of diameters between 0.458 and 45.8 microns as approximating the scattering properties of ice crystals; comparisons to the phase function of columnlike hexagonal prisms showed the assumption to be reasonable. The observed optical depths are strongly dependent on the acceptance angle of the sun photometer because of the strong solar aureole. However, the amount of precipitable water may be accurately determined with a 2 degree FOV photometer using the ratio of two wavelengths, one strongly absorbing band for H₂O and the other transmitting. Author

A86-21260#**A SIMPLE APPROACH TO ESTIMATE CLIMATOLOGICAL VARIABLES AT UNGAUGED POINTS FROM SATELLITE IMAGES AND SCARCE GROUND DATA TWO CASE STUDIES ABOUT RAINFALL AND SUNSHINE DURATION**

D. CREUTIN, Y. FREIN, S. GALLE, P. LACOMBA, and C. OBLED (Grenoble I, Universite, France) IN: International Symposium on Remote Sensing of Environment, 18th, Paris, France, October 1-5, 1984, Proceedings. Volume 3. Ann Arbor, MI, Environmental Research Institute of Michigan, 1985, p. 1873-1882. refs

A86-21261#**USE OF AIRBORNE MULTISPECTRAL SCANNER DATA FOR QUANTITATIVE WATER QUALITY STUDY OF THE TANSHUI RIVER**

C. WU, C. LU, and W. CHENG (Energy and Mining Research/Service Organization, Taipei, Republic of China) IN: International Symposium on Remote Sensing of Environment, 18th, Paris, France, October 1-5, 1984, Proceedings. Volume 3. Ann Arbor, MI, Environmental Research Institute of Michigan, 1985, p. 1885-1893. refs

Remotely sensed data were obtained from four flight lines flown over the Tanshui River watershed in northern Taiwan using an airborne Daedalus model 1260 eleven-channel Multispectral Scanner (MSS). At the same time, water samples from sixteen

stations were acquired to measure fourteen water quality parameters in the laboratory. The measurements of water truth were used to calibrate the MSS data by the stepwise regression technique. All water quality parameters showed high correlation with the airborne data. A density slicing technique was exploited to produce thematic maps showing the relative quantitative distribution of water quality variables in the target areas. D.H.

A86-21265#**HYDRODYNAMIC MODELLING FOR DETERMINATION OF SUSPENDED SEDIMENT CONCENTRATIONS IN THE ASWAN RESERVOIR USING SATELLITE DATA**

S. E. SMITH (Ohio State University, Columbus), A. EL DARWISH (Aswan High Dam Authority, Egypt), and A. AYOUB (Egyptian Academy of Scientific Research and Technology, Cairo, Egypt) IN: International Symposium on Remote Sensing of Environment, 18th, Paris, France, October 1-5, 1984, Proceedings. Volume 3. Ann Arbor, MI, Environmental Research Institute of Michigan, 1985, p. 1929, 1930.

A86-22646**REMOTE SENSING INLAND WETLANDS - A MULTISPECTRAL APPROACH**

J. R. JENSEN, M. E. HODGSON, R. CHRISTENSEN (South Carolina, University, Columbia), H. E. MACKEY, JR. (Du Pont de Nemours Savannah River Laboratory, Aiken, SC), L. R. TINNEY (EG&G, Inc., Energy Measurements Group, Las Vegas, NV) et al. Photogrammetric Engineering and Remote Sensing (ISSN 0099-1112), vol. 52, Jan. 1986, p. 87-100. refs (Contract DE-AC09-76SR-00001)

Airborne Multispectral Scanner (MSS) data, large-scale aerial photography, and Landsat MSS and Thematic Mapper (TM) data were used to map a variety of wetland conditions along the Savannah river watershed in South Carolina. Predawn thermal infrared MSS imagery were analyzed to map the spatial distribution and migration of thermal effluent entering a portion of the Savannah river floodplain and the Savannah River below Augusta, Georgia. Daytime airborne MSS data were used to classify specific wetland vegetation types and associate them with their apparent (remotely sensed) temperature. Large-scale, multiple date aerial photography was ideally suited to follow the vegetational changes associated with the thermal discharges into the floodplain. Landsat MSS imagery obtained in the spring was used effectively to map the entire Savannah River watershed. Landsat TM imagery obtained in the summer was of limited use in regional wetland mapping. Author

A86-22846**THE POTENTIAL USE OF SPOT HRV IMAGERY FOR ANALYSIS OF COASTAL SEDIMENT PLUMES**

L. E. BAND (Hunter College, New York), H. L. MCKIM, and C. J. MERRY (U.S. Army, Cold Regions Research and Engineering Laboratory, Hanover, NH) IN: SPOT simulation applications handbook; Proceedings of the SPOT Symposium, Scottsdale, AZ, May 20-23, 1984. Falls Church, VA, American Society of Photogrammetry, 1984, p. 199-204. Army-supported research. refs

The use of SPOT high resolution visible data obtained on July 7, 1984 to monitor sediment movement in and around the Hart-Miller Island complex is examined. The application of the edge detection technique (Sobel operator) to the SPOT image is studied; two sets of edge segments that follow the boundaries of the major sediment plumes are generated, with edge intensity stronger nearer the source. The spatial pattern of the plume edges, and tonal and textural differences on the image are investigated. Analysis of the SPOT image reveals that source and transport direction of the plumes, and concentrations of suspended sediments are observed. I.F.

A86-22848* National Aeronautics and Space Administration. Goddard Inst. for Space Studies, New York.

SPATIAL ANALYSIS IN RECREATION RESOURCE MANAGEMENT FOR THE BERLIN LAKE RESERVOIR PROJECT

H. A. EDUARDO, M. KORYAK (U.S. Army, Engineer District, Pittsburgh, PA), M. S. MILLER (NASA, Goddard Institute for Space Studies; Sigma Data Services Corp., New York), H. WILSON (NASA, Goddard Institute for Space Studies; Columbia University, New York), C. J. MERRY (U.S. Army, Cold Regions Research and Engineering Laboratory, Hanover, NH) et al. IN: SPOT simulation applications handbook; Proceedings of the SPOT Symposium, Scottsdale, AZ, May 20-23, 1984. Falls Church, VA, American Society of Photogrammetry, 1984, p. 209-219.

Spatial analysis of geographic information systems and the acquisition and use of remotely-sensed data within the U.S. Army Corps of Engineers is an emerging Technology Work units have been developed under the Remote Sensing Research and Development Program, which are most relevant to the productive needs of the Corps in both the military and civil works missions. Corps participation in the SPOT simulation campaign is one such example of this research. This paper describes the application of spatial analysis and remote sensing in recreation resource management planning at the Berlin Lake Reservoir Project within the Pittsburgh District. SPOT simulator data was acquired over Berlin Lake, Site No. 10, on July 8, 1983. The first part of this paper describes the background of the U.S. Army Corps of Engineers and the Berlin Lake project, the geographic information system being developed, and the planned use of SPOT and similar data. The remainder of the paper describes the results on an analysis of the simulated SPOT data conducted at the NASA Goddard Institut for Space Studies.

Author

A86-22850

VEGETATIVE COVER AND HYDROLOGIC TRANSPORT STUDIES IN THE BITUMINOUS COAL FIELDS OF PENNSYLVANIA USING SIMULATED SPOT DATA

N. F. PARKS, K. F. CONNORS, G. W. PETERSEN, T. W. GARDNER, J. R. EYTON (Pennsylvania State University, University Park) et al. IN: SPOT simulation applications handbook; Proceedings of the SPOT Symposium, Scottsdale, AZ, May 20-23, 1984. Falls Church, VA, American Society of Photogrammetry, 1984, p. 229-238. refs
(Contract DE-AC02-83ER-60182)

Simulated SPOT data have been assessed for delineation of vegetation and hydrologic transport processes in a humid coal mining region of central Pennsylvania. The data were collected on July 8, and corresponding Landsat-4 data were collected on July 7, 1983. Previously-collected ground truth and aerial photographs facilitated evaluation. Image analysis and digital classification techniques were used, with emphasis on classification of vegetation and coal spoil surfaces. Spoil pile surface features are important in monitoring reclamation success, including the establishment of vegetation cover, initiation of gully development, and the production of acid mine drainage. Different vegetation species, age classes, and cover densities were separated by maximum likelihood classification. The Euclidean distance classifier differentiated among spoil lithologies, and between water bodies that were affected by acidic mine drainage and those that were unaffected. This research demonstrated the potential role of SPOT data in creation of an integrated data base to support studies of energy-related surface and subsurface waste transport systems.

Author

A86-24520* Alabama Univ., Huntsville.

INFRARED REMOTE SENSING OF CONVECTIVE CLOUDS AND AMOUNT OF RAINFALL OVER THE TIBET PLATEAU AREA

R. J. HUNG, J. M. LIU (Alabama, University, Huntsville), and R. E. SMITH (NASA, Marshall Space Flight Center, Huntsville, AL) Annales Geophysicae (ISSN 0755-0685), vol. 3, Nov.-Dec. 1985, p. 767-775. refs
(Contract NAS8-33726)

The pattern of heavy rainfall in the Tibet Plateau area is usually preceded by a high growth rate of the convective clouds followed by a rapid collapse of the cloud top as observed on satellite infrared remote images. This study shows that the amount of rainfall can be estimated from the volumetric dissipation of clouds per unit area passing through the area of interest. This study also shows that the ratio of ground observed rainfall over the volumetric dissipation of clouds per unit area is constant for relatively heavier rainfall, and is smaller for very light rainfall. This is due to the fact that the lighter rainfall consumes higher percentage of rain drops in evaporation before they reach the ground.

Author

A86-24616

GEOMORPHOLOGICAL AND LAND-USE ANALYSES OF COLOR IR PHOTOGRAPHS FROM THE SPACELAB-1 MISSION [INTERPRETATION D'UN COUPLE DE PHOTOGRAPHIES INFRAROUGE COULEUR DE LA MISSION SPACELAB-1 DANS LES DOMAINES DE LA GEOMORPHOLOGIE ET DE L'OCCUPATION DU SOL]

Y. DEWOLF, F. JOLY (Paris VII, Universite, France), J. BESSAC, and A. SIMONIN (CNRS, Centre d'Etudes et Realisations Cartographiques Geographiques, France) Societe Francaise de Photogrammetrie et de Teledetection, Bulletin (ISSN 0244-6014), no. 99, 1985, p. 35-39. In French.

Several Spacelab-1 color IR photographs of the North Paris Basin were combined with each other to perform geomorphological and land use analyses of stereoscopic views of the region. The survey covered the steep cliffs to the sand dune beaches of the coast where the estuaries of the Seine enter the Atlantic. The photographic resolution was high enough to discern the petroleum terminal at Cape Antifer and the timber forests near Dieppe. The hydrologic drainage of the region was mapped at a 1:820,000 scale, including the areas which receive more drainage and the gravel basins cut by the rivers in the scenes. Lineaments, escarpments and terrain relief were also revealed. Few tree species could be identified because of the season of the photographs, while the layout of the farms, cities and the road systems were easily identified.

M.S.K.

A86-25480

EVALUATION OF THE QUALITY OF SURFACE WATER ON THE BASIS OF MULTISPECTRAL REMOTE-SENSING IMAGERY [OTSENKA KACHESTVA POVERKHNOSTNYKH VOD SUSHI PO MNOGOZONAL'NOI AEROKOSMICHESKOI VIDEOINFORMATSI]

A. A. GITELSON, G. P. KEIDAN, and V. N. SHISHKIN (Rostovskii Gosudarstvennyi Universitet, Rostov-on-Don, USSR) Issledovanie Zemli iz Kosmosa (ISSN 0205-9614), Nov.-Dec. 1985, p. 28-35. In Russian. refs

An algorithm based on radiation parameters invariant with respect to survey conditions is developed for assessing surface-water quality. Interpretation signatures are identified that can be used to determine the hydrochemical and hydrobiological indicators of water objects from radiation characteristics. Radiation vs. concentration relationships for mesotrophic waters are examined with a view to developing an a priori data bank for the interpretation of multispectral imagery.

B.J.

N86-16689*# Maryland Univ., College Park. Remote Sensing Systems Lab.

ACTIVITIES OF THE PILOT LAND DATA SYSTEM PROJECT Interim Progress Report

J. K. SIRCAR, Principal Investigator 15 Nov. 1985 5 p ERTS (Contract NAG5-512)

(E86-10023; NASA-CR-176377; NAS 1.26:176377) Avail: NTIS HC A02/MF A01 CSCL 05B

The University of Maryland's Remote Sensing Systems Laboratory submitted to NASA/Goddard an interim progress report on the work being conducted within its Pilot Land Data System IPLDS project. The Remote Sensing Systems Laboratory addressed the following tasks: (1) identify data types and data sources needed to describe the selected test sites in collaboration with Goddard's Hydrological Sciences Branch; (2) define the procedures necessary to access/acquire this data; (3) conduct meetings with the PLDS Systems Engineering Group to identify functional specification priorities for PLDS development; (4) assemble documentation on historical remotely sensed imagery and transfer of such information to the PLDS Data Management Group; (5) collect data identified by Goddard's Hydrological Sciences Branch for data set inventory in PLD; (6) develop a Workstation-PLDS system interface over high speed lines, (7) develop and test through a Phase 1 demonstration of a micro workstation to access PLDS; and (8) establish interdepartmental agreement of development of computer link for electronic access of water resources data from USGS.

Author

N86-16704# Pacific Northwest Lab., Richland, Wash.
OPPORTUNITIES AND DIFFICULTIES ASSOCIATED WITH USING LANDSAT THEMATIC MAPPER DATA FOR DETERMINING SURFACE WATER TEMPERATURES

G. W. WUKELIC, J. C. BARNARD, G. M. PETRIE, and H. P. FOOTE Jun. 1985 14 p refs Presented at the NASA LIDQU Final Symposium: LANDSAT Image Data Quality Analysis Meeting, Indianapolis, Ind., 9 Sep. 1985

(Contract DE-AC06-76RL-01830) (DE85-017925; PNL-SA-13259; CONF-8509161-1) Avail: NTIS HC A02/MF A01

This paper describes results of research efforts to estimate surface-water temperatures using LANDSAT 4 and 5 TM thermal band data. Recent research involved the analysis of day- and night-time TM Band 6 data in both corrected (P tape) and uncorrected (A tape) formats. Results reported are for: (1) a reservoir reactor cooling system (PAR Pond) at the Department of Energy's (DOE) Savannah River Plant in Aiken, South Carolina, and (2) the Columbia River adjacent to the DOE's Hanford site in southeastern Washington State. Differences between LANDSAT-derived surface water temperatures and ground truth values before and after correcting for atmospheric effects (using LOWTRAN) are described. The results substantiate the consistent performance of the LANDSAT TM thermal sensor for providing potentially useful estimates of relative and absolute temperatures for large water bodies within and between TM scenes. In addition, technical difficulties encountered that currently limit routine use of such data for environmental monitoring, such as calibration, mixed pixel phenomena, and atmospheric effects are addressed. DOE

N86-18357# Katholieke Universiteit te Leuven (Belgium). Remote Sensing Lab.

APPLICATION OF METEOSAT DATA FOR REMOTE SENSING OF EARTH RESOURCES: EARSSEL WORKING GROUP 7 REPORT

R. GOMBEER /In ESA Proceedings of EARSSEL/ESA Symposium on European Remote Sensing Opportunities: Systems, Sensors, and Applications p 43-44 Jun. 1985

Avail: NTIS HC A12/MF A01

Algorithms to map rainfall, net radiation, evapotranspiration, soil moisture availability, thermal inertia, and germination were developed, using METEOSAT data and standard reports from synoptic weather and rainfall stations in arid zones. The algorithms were applied to a test area in Mali to map and monitor these variables during a test period of 18 days at the beginning of the

growing season. Results demonstrate the ability of METEOSAT to provide consistent surface meteorological maps over large areas, and unique information in areas where ground stations are scarce or existing measurements unreliable. Results on rainfall, evapotranspiration, germination and biomass were represented in color maps.

Author (ESA)

N86-18358# Bristol Univ. (England).

SATELLITE REMOTE SENSING IN HYDROLOGY

R. W. HERSHEY (ESA/ESTEC, Noordwijk, Netherlands), E. C. BARRETT, and J. N. ROOZEKRANS (Environmental Analysis and Remote Sensing, Delft, Netherlands) /In ESA Proceedings of EARSSEL/ESA Symposium on European Remote Sensing Opportunities: Systems, Sensors, and Applications p 47-53 Jun. 1985

Avail: NTIS HC A12/MF A01

The needs of satellite remote sensing techniques for hydrology and water management were studied. The status of remote sensing in hydrology is described and existing and future satellite systems are discussed. Further requirements of satellite sensors for hydrology and water management are considered. The results of a questionnaire to 150 European hydrologists are summarized and the hydrological requirements from satellite remote sensing presented.

Author (ESA)

N86-18367# Institute for Land and Water Management Research, Wageningen (Netherlands).

EVAPORATION IN DESERTS: PHYSICAL ASPECTS AND REMOTE SENSING TECHNIQUES

M. MENENTI /In ESA Proceedings of EARSSEL/ESA Symposium on European Remote Sensing Opportunities: Systems, Sensors, and Applications p 99-106 Jun. 1985 refs

Avail: NTIS HC A12/MF A01

Physical processes which contribute to evaporation of bare soil under desert conditions are discussed. A combination equation to calculate actual evaporation when the evaporation front is located below the soil surface is presented. It is shown that thermal convection of soil air in the top soil can occur and that heat and vapor flow can be contrary, because of the density gradient induced by vapor production. The concept of thermal admittance of the surface is discussed in relation to the thermal properties of soil layers. Knowledge of the thermal properties of the soil layers is needed, since soil heat flux is the driving force for evaporation when it takes place below the soil surface. The application of satellite data to study these processes is discussed, and a case-study in the Libyan desert is presented. The relevance of groundwater losses by evaporation for a proper appraisal of groundwater resources in deserts is emphasized. Author (ESA)

N86-18381# Consiglio Nazionale delle Ricerche, Milan (Italy). Remote Sensing Dept.

SNOW MAPPING FROM LANDSAT IMAGERY

G. BOLZAN, P. A. BRIVIO, L. CILLERAI, A. DELLAVENTURA, and A. RAMPINI /In ESA Proceedings of EARSSEL/ESA Symposium on European Remote Sensing Opportunities: Systems, Sensors, and Applications p 211-216 Jun. 1985 refs

Avail: NTIS HC A12/MF A01

A dedicated system for the analysis of satellite images and snow cover measures drawing, and multispectral scanner results obtained by its application to a series recorded over Cordevole River basin test site (Italy) are presented. The system includes procedures for the processing, classification, and display of the images, allowing the analyst to drive and control the whole process. Comparison between snow maps automatically compiled and photointerpretation maps shows a good agreement.

Author (ESA)

06 HYDROLOGY AND WATER MANAGEMENT

N86-18385# Mullard Space Science Lab., Dorking (England). THE ERS-1 OBSERVATIONS OF LAKES FOR CLIMATE RESEARCH

I. M. MASON, C. G. RAPLEY, F. A. STREET-PERROTT (Oxford Univ.), and M. GUZKOWSKA (Oxford Univ.) *In* ESA Proceedings of EARSeL/ESA Symposium on European Remote Sensing Opportunities: Systems, Sensors, and Applications p 235-241 Jun. 1985 refs Sponsored by ESA and UK Science and Engineering Research Council
 Avail: NTIS HC A12/MF A01

Prospects for remote sensing of lake volume fluctuations for climate research using ERS-1 are reviewed. The importance of monitoring lake volumes for climate and paleoclimate research, and how closed lakes respond to climate are considered. It is shown that it is necessary to monitor levels and areas simultaneously, which can be achieved using the Radar Altimeter (RA) and the Along Tracking Scanning Radiometer (ATSR) on ERS-1. For any frequency band the ATSR and RA can measure small (10%) aridity variations. The ATSR has virtually global coverage, and with a reasonably long repeat track period (35 days) the RA could measure up to 100 closed lakes globally and many more open ones. The ERS-1 can provide an important climate record on a global scale. Author (ESA)

N86-18769# Army Engineer Waterways Experiment Station, Vicksburg, Miss. Environmental Lab. MILITARY HYDROLOGY. REPORT 8: FEASIBILITY OF UTILIZING SATELLITE AND RADAR DATA IN HYDROLOGIC FORECASTING

B. T. MIERS and G. L. HUEBNER Sep. 1985 69 p
 (Contract DA PROJ. 4A7-62719-AT-40)
 (AD-A160615; WES/MP/EL-79-6-8) Avail: NTIS HC A04/MF
 A01 CSCL 08H

The army that has the capability of predicting hydrologic conditions throughout the battlefield area would have a tactical advantage on both offense and defense. Such a capability, though, is dependent on a means for accurately monitoring and forecasting precipitation, the dominant driving element for dynamic hydrologic phenomena such as soil moisture and streamflow. In the context of a tactical environment with its associated constraints, the potential utility of satellites and radars was evaluated. It was concluded that, in the 1980s time frame, only the weather radar can provide rainfall estimates meeting requirements of the military hydrologist. Common components and operational characteristics of existing radar systems are discussed, and a set of general specifications for a tactical weather radar system is included.

GRA

N86-19696# Helsinki Univ. of Technology, Espoo (Finland). MAPPING OF SNOW BY PASSIVE AND ACTIVE MICROWAVE SENSORS

M. HALLIKAINEN and R. KUITTINEN (Technical Research Centre of Finland, Espoo) *In* ESA The Use of Satellite Data in Climate Models p 131-132 Sep. 1985 refs
 Avail: NTIS HC A10/MF A01

A snow-related research program for ERS-1 is proposed. Discrimination of wet snow (melting season) from bare soil is possible using the SAR and the wind scatterometer. Special attention should be paid to observing the effects from various land-cover categories to the discrimination accuracy. With the SAR, the 25m resolution makes it possible to distinguish in a detailed manner backscattering contributions from land-cover categories. With the wind scatterometer, the situation is comparable to corresponding Nimbus-7 SMMR studies (resolution tens of kilometers). The data should be complemented with airborne gamma spectrometer measurements, NOAA data, Nimbus-7 SMMR (or DMSP/N-ROSS SSM/I) data, and in situ measurements. Finland is an excellent test site for snow studies. Author (ESA)

N86-19697# Innsbruck Univ. (Austria). Inst. of Meteorology and Geophysics.

MONITORING OF SNOW AND LAND ICE PARAMETERS: POSSIBILITIES AND CONSTRAINTS OF SAR AND MICROWAVE IMAGING SYSTEMS

H. ROTT *In* ESA The Use of Satellite Data in Climate Models p 133-135 Sep. 1985 refs
 Avail: NTIS HC A10/MF A01

Global monitoring of cryospheric parameters using satellite-borne radar and microwave imaging systems, especially ERS-1, is considered. The different capabilities regarding dry and wet snow cover clearly indicate a combination of SAR and microwave radiometer as optimum snow sensor. However major differences in areal coverage and spatial resolution complicate the synergistic use of these sensors. An SMMR-like sensor provides global coverage in 3 days of operation. The spatial resolution (30 km in the 37 GHz-channel) is adequate for large scale climate studies. An improvement of resolution to a few kilometers appears feasible without major technical problems. The ERS-1 Active Microwave Instrument narrow swath and the restrictions in sensor operation time mean that the system can be used for detailed studies only over a few limited areas. The ERS-1 SAR system has only supplementary functions for land cryosphere monitoring and is of limited value for climatological studies on snow and land ice. A potential operational application is the surveillance of lake and river ice. Author (ESA)

N86-19804# Colorado State Univ., Fort Collins. Dept. of Atmospheric Science.

EFFECTS OF MOUNTAIN RANGES ON MESOSCALE SYSTEMS DEVELOPMENT Final Report, 15 Apr. 1982 - 31 Jul. 1985

E. R. REITER, J. D. SHEAFFER, M. A. KLITCH, and R. L. MCANELLY Sep. 1985 191 p
 (Contract AF-AFOSR-0162-82)
 (AD-A161136; AFOSR-85-0924TR) Avail: NTIS HC A09/MF
 A01 CSCL 04B

Synoptic studies addressed themselves to a moisture bridge over Central America which often is tied to severe weather in the Rocky Mountain area. Heavy flooding events over eastern China have been tied to preferred positions of blocking highs and to vortices developing over the Plateau of Tibet. Mesoscale convective systems over, and to the east of, the U.S. Rocky Mountains have been investigated by individual case studies as well as by satellite composite imagery. There appears to be a well-defined sequence of events, whereby first the average precipitation rate maximizes, then the volumetric rain rate, and finally the rain area. Appendices: a satellite climatology of intense convective storms from manually digitized hourly cloud cover fields; meso-beta-scale characteristics of the meso-alpha-scale convective complex; evolution of precipitation and upper air characteristics during the life-cycle of a composite mesoscale convective complex; the precipitation life cycle of mesoscale convective complexes. GRA

N86-20253# Joint Publications Research Service, Arlington, Va. DETERMINING WATER SURFACES IN NORTHWESTERN BOHEMIA FROM SATELLITE DATA Abstract Only

K. KIRCHNER, J. KOLAR, and S. PLACHY *In* its USSR Report: Space (JPRS-USP-86-001) p 149 13 Jan. 1986 Transl. into ENGLISH from Issledovaniye Zemli iz Kosmosa (Moscow, USSR), no. 1, Jan. - Feb. 1985 p 47-51 Original language document was announced in IAA as A85-29906
 Avail: NTIS HC A03

Satellite data were used in determining surface water formations in the territory of Czechoslovakia. An analysis is given of a photograph of northwestern Bohemia which is characterized by a well-expressed dynamics of surface changes attributable to economic activity. The photograph was taken from the LANDSAT satellite on 30 June 1978. One of the manifestations of these changes is the appearance or disappearance of some water bodies in a relatively short time interval which necessitates corrections to topographic and geographic maps. A test range with an area of about 600 square kilometers was defined in the studied area. This is a mining region where open pits and mine tailings become

filled or flooded with water. The water surfaces have different extents and configurations determined by the nature of the depression, hydrogeological and climatic conditions. The initial form of the information used in the study was the spectral characteristic of the water surface. The information used in the classification of water surfaces as from a single spectral channel for the near-IR region. A total of about 135,000 brightness values were obtained for the test range. Some 96 water surfaces of different extent were detected. These image data were compared with water surfaces on topographic maps at 1:25,000 and 1:50,000 and water surfaces on black-and-white panchromatic aerial photographs at 1:20,000. It was possible to make reliable identification of water bodies with an area greater than 1 hectare. R.J.F.

N86-20446# Joint Publications Research Service, Arlington, Va.
RADAR OBSERVATIONS OF RIVER OVERFLOWS FROM OUTER SPACE Abstract Only

A. P. PICHUGIN, A. S. GAVRILENKO, A. G. GRIBUNIN, L. V. YELENSKIY, A. I. KALMYKOV, and V. P. SHESTOPALOV *In its* USSR Report: Space (JPRS-USP-86-002) p 63 10 Feb. 1986 Transl. into ENGLISH from Doklady Akademii Nauk SSSR (Moscow, USSR), v. 284, no. 2, Sep. 1985 p 323-326 Original language translation was announced in IAA as A86-13984
 Avail: NTIS HC A05

Cosmos-1500 sidelooking radar observations of the flooding of the Amur River in August 1984 are examined. It is concluded that remote-sensing radar images can be effectively used to monitor river flooding and to identify the basic features of flooded regions. The proposed radar-image processing method makes it possible to compute the areas of regions with different degrees of flooding as well as the percentage of land under water. B.J.

N86-20888# Joint Publications Research Service, Arlington, Va.
AN-30 PHOTOGRAPHY AIRPLANE OUTFITTED FOR CLOUD-SEEDING MISSIONS

T. KUZNETSOVA and A. PIMENOV *In its* USSR Report: Earth Sciences (JPRS-UES-86-001) p 1-2 10 Jan. 1986 Transl. into ENGLISH from Pravda Ukrainy (Kiev, USSR), 15 Aug. 1985 p 4
 Avail: NTIS HC A04

The development of the AN-30M airplane mode, which can modify the weather is discussed. It has excellent flight qualities, high reliability, and modern pilotage-and-navigation equipment that permits flight routes and course changes in the semiautomatic mode and takeoffs during daytime and nighttime, in difficult weather conditions. Ammunition against precipitation (crystalline and other reagents) is loaded into containers placed inside and outside the aircraft on external mounts with a streamlined shape. The instruments evaluate weather conditions outside the airplane and decide at what altitude the cloud cover should be seeded and on the methods to be used. The AN-30M seeds clouds with frozen carbon dioxide granules. The plane can induce additional rainfall on farmlands, increase snow cover, and extinguish forest fires. E.A.K.

N86-20976# Oak Ridge National Lab., Tenn.
INVESTIGATION OF LANDSCAPE AND LAKE ACIDIFICATION RELATIONSHIPS Interim Report

R. M. RUSH, R. B. HONEA, E. C. KRUG, R. W. PEPLIES, J. E. DOBSON, and F. P. BAXTER Oct. 1985 39 p
 (Contract DE-AC05-84OR-21400)
 (DE86-001450; ORNL/TM-9754) Avail: NTIS HC A03/MF A01

This interim report presents the rationale and initial results for a program designed to gather and analyze information essential to a better understanding of lake acidification in the northeastern United States. The literature pertinent to a study of landscape and lake acidification relationships is reviewed and presented as the rationale for a landscape/lake acidification study. The results of a study of Emmons Pond in northwestern Connecticut are described and lead to the conclusion that a landscape change was a contributor to the acidification of this pond. A regional study of sixteen lakes in southern New England using LANDSAT imagery is described, and preliminary observations from a similar study in

the Adirondack Mountains are given. These results indicate that satellite imagery can be useful in identifying types of ground cover important to landscape/lake acidification relationships. DOE

07

DATA PROCESSING AND DISTRIBUTION SYSTEMS

Includes film processing, computer technology, satellite and aircraft hardware, and imagery.

A86-19410

A DIGITAL ELEVATION MODEL OF THE BARNES ICE-CAP DERIVED FROM LANDSAT MSS DATA

G. D. LODWICK and S. H. PAINE (Calgary, University, Canada) Photogrammetric Engineering and Remote Sensing (ISSN 0099-1112), vol. 51, Dec. 1985, p. 1937-1944. Sponsorship: Department of Energy, Mines, and Resources of Canada. refs (Contract DEMR-OSO-80-00357; DEMR-OST-83-00180)

Two Multispectral Scanner images, taken by Landsat-1 and -2, were analyzed to extract topographical data for the Barnes ice cap of Baffin Island. The images were obtained at high and low solar azimuth and elevation. A principal components analysis was performed on a 600 x 600 pixel area of band 7 of the summer scene and on the brightness values of the winter scene. Polynomial equations were defined to account for sensor delay, earth rotation, swath continuous errors and global continuous errors. Nearest neighbor resampling techniques were used to overlay the adjusted images. Histograms of the video response levels were then employed to plot slope values by the recorded reflectances. The method yielded height contour values which corresponded well with a map of the cap. It is concluded that the availability of two images which have the largest difference in the solar azimuth, combined with estimates of the maximum slopes present in a scene, can permit the characterization of topographical characteristics with a 50 m resolution. M.S.K.

A86-19479* National Aeronautics and Space Administration.
 Goddard Space Flight Center, Greenbelt, Md.

ATMOSPHERIC EFFECTS ON REMOTE SENSING OF SURFACE REFLECTANCE

Y. J. KAUFMAN (NASA, Goddard Space Flight Center, Greenbelt; Maryland, University, College Park, MD) IN: Remote sensing; Proceedings of the Meeting, Arlington, VA, May 1, 2, 1984. Bellingham, WA, SPIE - The International Society for Optical Engineering, 1984, p. 20-33. refs

This paper reviews the atmospheric effects on remote sensing of surface reflectance. The scattering and absorption of sunlight by atmospheric molecules and aerosols affects the quality of images of the surface remotely sensed from satellites and aircrafts. The concentration and characteristics of the atmospheric aerosols vary from place to place and vary with time. The effect of atmospheric aerosols on the upward radiance depends on their optical thickness, scattering phase function and absorption. These parameters result from the aerosol concentration, composition, and the relative humidity. For high resolution images the aerosol scale height is also of importance. The radiative transfer theory that predicts the atmospheric radiances for a given surface and atmosphere is a well established theory for the case of uniform surfaces (or low resolution data). Some radiative transfer models exist for nonuniform surfaces and others are being developed. Recent field experiment and laboratory simulation data confirm the need for these models and can be used for their testing. It is shown that the atmospheric effect reduces the apparent resolution of satellite imagery and causes errors in the classification of surface fields. Suggestions for correction procedures are given. Such corrections can be based on ground observations, on satellite radiances above dark areas, or on climatologic information, depending on the accuracy of the corrections needed. The chosen

correction algorithm depends also on the image resolution and the specific remote sensing application. Author

A86-19485

INTERPRETATION OF TOPOGRAPHIC RELIEF FROM DIGITAL MULTISPECTRAL IMAGERY

J. B. CAMPBELL, R. M. HARALICK, and S. WANG (Virginia Polytechnic Institute and State University, Blacksburg) IN: Remote sensing; Proceedings of the Meeting, Arlington, VA, May 1, 2, 1984. Bellingham, WA, SPIE - The International Society for Optical Engineering, 1984, p. 98-116. refs

The complexities of multispectral data and the large volumes of data involved affect the possibilities for an improvement of the data interpretation procedures. Such improvements will, therefore, depend upon the development of methods which minimize use of scene-specific information, or methods which reduce or simplify interactions with the analyst. The present paper provides a description of a procedure for the interpretation of drainage and topographic information from monoscopic multispectral images. A minimum of prior information pertaining to a scene is used, and only a modest degree of operator interaction occurs during the analysis of a scene. The considered procedure employs a variety of techniques derived from classical remote sensing. However, there is also a development of new methods which exploit knowledge of spatial and geometric relationships within the data. The discussed method permits the inference of a relative elevation model from a Landsat scene of mountainous terrain. G.R.

A86-19486* Jet Propulsion Lab., California Inst. of Tech., Pasadena.

DATA SYSTEM CONSIDERATIONS FOR REMOTE SENSING

F. C. BILLINGSLEY (California Institute of Technology, Jet Propulsion Laboratory, Pasadena) IN: Remote sensing; Proceedings of the Meeting, Arlington, VA, May 1, 2, 1984. Bellingham, WA, SPIE - The International Society for Optical Engineering, 1984, p. 117-128. NASA-supported research. refs

The availability of data obtained with the aid of Landsat and other remote sensing satellites provides potentially the possibility to study problems on a global scale. Difficulties arise, however, in connection with the diversity of data formats, archival conditions, and the need for data registration. Systems are being planned to test the ability to reduce some of these difficulties. Details regarding the given situation are examined, taking into account global problems which are being considered. These problems are related to the global carbon dioxide cycle, and the biogeochemical cycle. Attention is given to pilot data systems, considerations for spatial data, data format considerations, data quality considerations, aspects of data base design, and system aids. G.R.

A86-19499

A CLASS OF NEW STATISTICAL DECISION ALGORITHMS FOR SOLVING PROBLEMS OF CIVIL SPACE REMOTE SENSING

N. A. NECHVAL (Rizhskii Institut Inzhenerov Grazhdanskoi Aviatsii, Riga, Latvian SSR) IN: Recent advances in civil space remote sensing; Proceedings of the Meeting, Arlington, VA, May 3, 4, 1984. Bellingham, WA, SPIE - The International Society for Optical Engineering, 1984, p. 68-75.

A technique for analytically solving problems of civil space remote sensing is developed on the basis of statistical decision theory, estimation theory, and optimization theory. The technique, utilizing the statistical invariant coupling method, is applied to the specific problems of determining signal detection thresholds and remotely measuring the thickness of surface cover. The proposed approach is applicable to the study of detection anomalies on the earth surface, resource exploration, fishery management, and ship routing during winter navigation. B.J.

A86-19609

KNOWLEDGE-BASED CLASSIFICATION

MULTI-SPECTRAL

IMAGE

M. J. CARLOTTO, V. T. TOM, P. W. BAIM, and R. A. UPTON (Analytic Sciences Corp., Reading, MA) IN: Applications of digital image processing VII; Proceedings of the Meeting, San Diego, CA, August 21-24, 1984. Bellingham, WA, SPIE - The International Society for Optical Engineering, 1984, p. 47-53. refs

A new approach to the problem of classifying surface materials in satellite multi-spectral imagery is described and demonstrated in this paper. Surface material classes are defined heuristically using rules which describe the typical appearance of the material under specified conditions in terms of relative image measures. A knowledge-based approach allows expert knowledge of the domain to be used directly to develop classification rules. An expert system is currently being developed in the Zetalisp/Flavors programming environment on the Symbolics 3600 Lisp Machine. An example of its use in classifying Landsat Thematic Mapper imagery is presented. Author

A86-20657

ORDERING OF TIME-DIFFERENCE INFORMATION FROM REPEATED SPATIAL IMAGERY

S. E. INGEBRITSEN and P. SWITZER (Stanford University, CA) IN: Spatial information technologies for remote sensing today and tomorrow; Proceedings of the Ninth Pecora Symposium, Sioux Falls, SD, October 2-4, 1984. Silver Spring, MD, Institute of Electrical and Electronics Engineers, Inc., 1984, p. 46-50. refs

The goal of the present study is to exhibit a time-differenced multiband spatial field in factored form so as to emphasize the spatially structured signal differences and isolate the spatially unstructured noise. The method used is a variant of the MAF procedure described in Switzer and Green (1984). The MAF procedure (Min/Max Autocorrelation Factors) is a general purpose technique which extracts p orthogonal linear combinations or factors of the p -variate data which have maximal to minimal spatial autocorrelation. Two examples of MAF-processed time-difference imagery are presented. The first example is from an area in the Okanogan Highlands province of Washington state; the second is from the western Carson Desert, Nevada. Both examples were generated from Landsat MSS image pairs. Author

A86-20658* Kent State Univ., Ohio.

THE SPATIAL STRUCTURE OF TERRAIN - A PROCESS SIGNAL IN SATELLITE DIGITAL IMAGES

R. G. CRAIG (Kent State University, OH) IN: Spatial information technologies for remote sensing today and tomorrow; Proceedings of the Ninth Pecora Symposium, Sioux Falls, SD, October 2-4, 1984. Silver Spring, MD, Institute of Electrical and Electronics Engineers, Inc., 1984, p. 51-54. refs
(Contract NAG5-165; NAS5-26111)

Pattern recognition procedures applied to Landsat imagery carry an implicit assumption that the digital data are independently distributed. That assumption is incorrect over virtually any terrain. Deviations from independence occur because slopes follow a systematic pattern of variation arising from the slope-forming processes. That pattern can be identified using the stochastic process methodology of Box and Jenkins. Angles of adjacent slopes are autocorrelated and the bidirectional reflectance function transfers these systematic slope changes to the sensor. Imagery becomes autocorrelated through this transfer. Autocorrelation in the imagery can be removed through direct calculation from a digital elevation model or by use of stochastic process methodology. The latter has the advantage that the residuals are white noise; and it is applicable in any area, even where a D.E.M. is unavailable. The stochastic process signal can be used to study terrain processes. Author

A86-20659

APPLICATION OF THE THEORY OF REGIONALIZED VARIABLES TO THE SPATIAL ANALYSIS OF LANDSAT DATA

J. R. CARR (Missouri-Rolla, University, Rolla) and D. E. MYERS (Arizona, University, Tucson) IN: Spatial information technologies for remote sensing today and tomorrow; Proceedings of the Ninth Pecora Symposium, Sioux Falls, SD, October 2-4, 1984. Silver Spring, MD, Institute of Electrical and Electronics Engineers, Inc., 1984, p. 55-61. refs

A regionalized variable is a random variable distributed in space. With respect to nearby variables, a regionalized variable is spatially correlated. That is, a regionalized variable is related to other variables as a function of the euclidean distance separating these variables. As the distance between two regionalized variables increases, for example, the two variables become more dissimilar. The theory of regionalized variables was developed to describe the spatial relationship between regionalized variables and to use this spatial information in estimating the value of a regionalized variable at an unsampled location. Landsat data represent spatial variations in reflected solar flux and the theory of regionalized variables was employed to quantify this spatial variance and hence demonstrate Landsat data to be regionalized variables. The benefit is the demonstration of a spatial processing technique based on the spatial structure shown by the Landsat data. Author

A86-20669*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

THE PILOT CLIMATE DATA SYSTEM

M. G. REPH, L. A. TREINISH, and P. H. SMITH (NASA, Goddard Space Flight Center, Greenbelt, MD) IN: Spatial information technologies for remote sensing today and tomorrow; Proceedings of the Ninth Pecora Symposium, Sioux Falls, SD, October 2-4, 1984. Silver Spring, MD, Institute of Electrical and Electronics Engineers, Inc., 1984, p. 132-139. refs

The Pilot Climate Data System (PCDS) is an interactive scientific information management system for locating, obtaining, manipulating, and displaying climate-research data. The PCDS was developed to manage a large collection of data of interest to the National Aeronautics and Space Administration's (NASA) research community and currently provides such support for approximately twenty data sets. In order to provide the PCDS capabilities, NASA's Goddard Space Flight Center (NASA/GSFC) has integrated the capabilities of several general-purpose software packages with specialized software for reading and reformatting the supported data sets. These capabilities were integrated in a manner which allows the PCDS to be easily expanded, either to provide support for additional data sets or to provide additional functional capabilities. This also allows the PCDS to take advantage of new technology as it becomes available, since parts of the system can be replaced with more powerful components without significantly affecting the user interface. Author

A86-20670*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

PILOT LAND DATA SYSTEM

P. J. CRESSY (NASA, Goddard Space Flight Center, Greenbelt, MD) and J. E. ESTES (California, University, Santa Barbara) IN: Spatial information technologies for remote sensing today and tomorrow; Proceedings of the Ninth Pecora Symposium, Sioux Falls, SD, October 2-4, 1984. Silver Spring, MD, Institute of Electrical and Electronics Engineers, Inc., 1984, p. 140-147. refs

During the fall of 1983, the Information Systems Office of NASA's Office of Space Science and Applications assembled a Working Group to develop initial plans for a Pilot Land Data System (PLDS). Workshops coordinated planning and concept development activities between land-related and computer science disciplines, and examined land research requirements, information science technology requirements, PLDS architecture, and methodologies for system evaluation. The PLDS will be a limited-scale distributed information system to explore scientific, technical and management approaches to satisfy land science research needs. PLDS will pave the way for a Land Data System to improve data access, processing, transfer and analysis, fostering an environment in which

land science information synthesis can occur on a scale not previously possible owing to limits to data assembly and access and efficiency of processing. Author

A86-20676

ADVANCED COMPUTER INTERPRETATION TECHNIQUES FOR EARTH DATA INFORMATION SYSTEMS

P. H. SWAIN (Purdue University, West Lafayette, IN) IN: Spatial information technologies for remote sensing today and tomorrow; Proceedings of the Ninth Pecora Symposium, Sioux Falls, SD, October 2-4, 1984. Silver Spring, MD, Institute of Electrical and Electronics Engineers, Inc., 1984, p. 184-189. refs

Consideration is given to the primarily pixel-oriented methods for analyzing remote sensing data which are in common practice today. Advanced computer interpretation techniques take advantage of the diverse forms of information in geobased information systems of which remote sensing data is only a part. Instrumentation advances and developments in space technology continue to make more information available from the spectral domain. Innovative methods are used to represent and manipulate high-dimensional data of this nature. Image registration and rectification techniques have made it possible to draw together geographic information from a great diversity of sources. Sophisticated scene models and methods for information extraction aim to take advantage of the generalized scene context, of which spatial and temporal data are only the most familiar components. This tutorial paper surveys many of the advanced computer interpretation techniques now in use and considers the directions which future research in this area will take. Author

A86-20677

MULTISPECTRAL IMAGE CONTEXT CLASSIFICATION USING THE MARKOV RANDOM FIELD

R. M. HARALICK, M. C. ZHANG, and J. B. CAMPBELL (Virginia Polytechnic Institute and State University, Blacksburg, VA) IN: Spatial information technologies for remote sensing today and tomorrow; Proceedings of the Ninth Pecora Symposium, Sioux Falls, SD, October 2-4, 1984. Silver Spring, MD, Institute of Electrical and Electronics Engineers, Inc., 1984, p. 190-200. refs

A new multispectral image context classification, which is based on a recursive algorithm for optimal estimation of the state of a two-dimensional discrete Markov Random Field, is presented. The implementation of the recursive algorithm is on a form of dynamic programming. Finally, experimental results with remote sensed multispectral scanner data using the recursive context classification are presented and contrasted with results from context free classification. Author

A86-20681#

PROCESSING OF SCANNED IMAGERY FOR CARTOGRAPHIC FEATURE EXTRACTION

S. P. BENJAMIN and L. GAYDOS (USGS, Menlo Park, CA) IN: Spatial information technologies for remote sensing today and tomorrow; Proceedings of the Ninth Pecora Symposium, Sioux Falls, SD, October 2-4, 1984. Silver Spring, MD, Institute of Electrical and Electronics Engineers, Inc., 1984, p. 222-230. refs

Digital cartographic data are usually captured by manually digitizing a map or an interpreted photograph or by automatically scanning a map. Both techniques first require manual photointerpretation to describe features of interest. A new approach, bypassing the laborious photointerpretation phase, is being explored using direct digital image analysis. Aerial photographs are scanned and color separated to create raster data. These are then enhanced and classified using several techniques to identify roads and buildings. Finally, the raster representation of these features is refined and vectorized.

Author

A86-20685*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

AN APPLICATION OF EXPERT SYSTEMS TECHNOLOGY TO REMOTELY SENSED IMAGE ANALYSIS

W. K. ERICKSON and W. C. LIKENS (NASA, Ames Research Center, Moffett Field, CA) IN: Spatial information technologies for remote sensing today and tomorrow; Proceedings of the Ninth Pecora Symposium, Sioux Falls, SD, October 2-4, 1984. Silver Spring, MD, Institute of Electrical and Electronics Engineers, Inc., 1984, p. 258-276. NASA-supported research. refs

In October of 1983, a project was initiated at NASA/Ames Research Center to design a prototype expert system capable of producing a preliminary land cover classification from an unsupervised classification of Landsat Multispectral Scanner (MSS) imagery and associated collateral data. This paper outlines the problem of determining land cover classes from an unsupervised classification, presents a brief overview of expert systems, and continues with a description of the design and current state of implementation of NASA/Ames' prototype Landsat MSS image analysis expert system. Author

A86-20692*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

A DEVICE-INDEPENDENT INTERFACE FOR INTERACTIVE IMAGE DISPLAY

D. C. PERKINS, M. R. SZCZUR, J. OWINGS, and S. CONTRACTOR (NASA, Goddard Space Flight Center, Greenbelt, MD) IN: Spatial information technologies for remote sensing today and tomorrow; Proceedings of the Ninth Pecora Symposium, Sioux Falls, SD, October 2-4, 1984. Silver Spring, MD, Institute of Electrical and Electronics Engineers, Inc., 1984, p. 325-330. refs

NASA's Goddard Space Flight Center (GSFC) has developed a Transportable Applications Executive (TAE) for use in implementing portable applications software that can be shared by different research projects. Since many of the supported disciplines require the interactive display and manipulation of remotely sensed images, a device independent Display Management Subsystem (DMS) was written as a TAE extension. The DMS attempts to abstract and standardize the device dependent functions that are used in the display and manipulation of image data on image analysis terminals. This paper explores the concept of DMS and the interface routines that are available to the applications programmer for use in developing a set of portable image display utility programs. Author

A86-20699* Kansas Univ., Lawrence.
USING SPATIAL LOGIC IN CLASSIFICATION OF LANDSAT TM DATA

J. W. MERCHANT (Kansas, University, Lawrence) IN: Spatial information technologies for remote sensing today and tomorrow; Proceedings of the Ninth Pecora Symposium, Sioux Falls, SD, October 2-4, 1984. Silver Spring, MD, Institute of Electrical and Electronics Engineers, Inc., 1984, p. 378-385. refs (Contract NGL-17-004-024)

A strategy for spatial/spectral classification of Landsat TM data is presented. The strategy is founded upon 'spatial logic', a logic that seeks to emulate important aspects of visual image interpretation. The carefully structured classification process begins with spectral stratification of the data into water, vegetated and non-vegetated pixels. A region growing algorithm is then used to define 'fields' of similar land cover composition. Fields are characterized by cover composition, size and neighborhood characteristics. A supervised iterative contextual classification algorithm is developed to assign final land use/land cover labels. Maps are generalized using a spatial post-processing technique. Positive, though preliminary, results are presented. Author

A86-20700*

A COMPARISON OF LANDSAT POINT AND RECTANGULAR FIELD TRAINING SETS FOR LAND-USE CLASSIFICATION

C. H. TOM (Hughes Aircraft Co., Englewood, CO) and L. D. MILLER (Nebraska Remote Sensing Center, Lincoln) IN: Spatial information technologies for remote sensing today and tomorrow; Proceedings of the Ninth Pecora Symposium, Sioux Falls, SD, October 2-4, 1984. Silver Spring, MD, Institute of Electrical and Electronics Engineers, Inc., 1984, p. 387-398. Research supported by the Colorado State University and NASA. refs

Rectangular training fields of homogeneous spectoreflectance are commonly used in supervised pattern recognition efforts. Trial image classification with manually selected training sets gives irregular and misleading results due to statistical bias. A self-verifying, grid-sampled training point approach is proposed as a more statistically valid feature extraction technique. A systematic pixel sampling network of every ninth row and ninth column efficiently replaced the full image scene with smaller statistical vectors which preserved the necessary characteristics for classification. The composite second- and third-order average classification accuracy of 50.1 percent for 331,776 pixels in the full image substantially agreed with the 51 percent value predicted by the grid-sampled, 4,100-point training set. Author

A86-20701

AN EVALUATION OF THE ACCURACIES OF FIVE ALGORITHMS FOR MACHINE CLASSIFICATION OF REMOTELY SENSED DATA

M. H. STORY, J. B. CAMPBELL, and G. BEST (Virginia Polytechnic Institute and State University, Blacksburg) IN: Spatial information technologies for remote sensing today and tomorrow; Proceedings of the Ninth Pecora Symposium, Sioux Falls, SD, October 2-4, 1984. Silver Spring, MD, Institute of Electrical and Electronics Engineers, Inc., 1984, p. 399-405. refs

Accuracies of five digital techniques applied to classify remotely sensed Landsat MSS data (of an area near Roanoke, VA) were assessed. The five algorithms, AMOEBA, ISODATA, BOSDEC, BCLAS, and Hypbox, vary considerably in terms of the information required for their use, which can be a limiting factor for their application. In terms of accuracy, the BOXDEC, BCLAS, and HYPBOX techniques were shown to be significantly more accurate than the AMOEBA and ISODATA. The BOXDEC technique displayed the highest degree of accuracy but took considerably more CPU time than other techniques and classified only 20.1 percent of the image. For a classification of the complete scene, the HYPBOX technique with the Bayes' rule option proved to be the most efficient (with respect to accuracy in relation to CPU time). I.S.

A86-21104*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

CHANGES IN CLASSIFICATION ACCURACY DUE TO VARYING THEMATIC MAPPER AND MULTISPECTRAL SCANNER SPATIAL, SPECTRAL, AND RADIOMETRIC RESOLUTION

W. ACEVEDO, J. S. BUIS (NASA, Ames Research Center; Technicolor Government Services, Inc., Moffett Field, CA), and R. C. WRIGLEY (NASA, Ames Research Center, Moffett Field, CA) IN: International Symposium on Remote Sensing of Environment, 18th, Paris, France, October 1-5, 1984, Proceedings. Volume 1. Ann Arbor, MI, Environmental Research Institute of Michigan, 1985, p. 27-44. refs

The present paper provides the results of a factorial experiment designed to study the classification differences resulting from varying TM and MSS sensor resolution. Eight simulated data sets of various TM and MSS spatial, spectral, and radiometric resolutions were generated on the basis of Daedalus aircraft scanner data. It is pointed out that the current study provides more precise results than previous work, because more exact methods of data simulation with regard to the three factors were emphasized. Two methods of analysis are considered in the paper. To improve on earlier studies, efforts were made to collect an extensive amount of ground reference data. The summaries of classification accuracies for the

training sites in the factorial analysis are presented in a table.

G.R.

A86-21105#

NEW DIGITAL ELEVATION MAPPING SOFTWARE APPLIED TO SPOT SIMULATION STEREO DATA

R. K. VINCENT, P. K. PLEITNER, D. H. COUPLAND, H. SCHULTZ, and E. R. B. OSHEL (Geospectra Corp., Ann Arbor, MI) IN: International Symposium on Remote Sensing of Environment, 18th, Paris, France, October 1-5, 1984, Proceedings. Volume 1. Ann Arbor, MI, Environmental Research Institute of Michigan, 1985, p. 47-54. refs

This article is concerned with a new software package, called ATOM for Automatic Topographic Mapper, which is a purely digital method for extracting elevations from aerial or space stereo pair photographs. The photos are digitized, and the resulting data are sent to disks connected to a DEC VAX 11/750 computer. ATOM calculates elevations and produces digital terrain data from which elevation contour maps can be made in less than one third the time required by a Gestalt plotter to produce a contour map from the same photos. When ATOM was applied to 1:68,000 scale aerial photos with base-to-height ratios of 0.6, a measured minimum detectable elevation difference of 2.83 meters was achieved. A 7.1-meter contour map was produced by ATOM which compares favorably with a 1:24,000 scale topographic map produced by the U.S. Geological Survey for an area near Soap Holes Reservoir, WY. The application of ATOM to 10-meter SPOT data should produce topographic contour maps which in the best case would compare favorably with 1:50,000 scale topographic maps.

Author

A86-21106#

A SCENE-DEPENDENT APPROACH TO SYNTHESIZING DIGITAL ELEVATION MODELS

R. R. IRISH and A. H. STRAHLER (Hunter College, New York) IN: International Symposium on Remote Sensing of Environment, 18th, Paris, France, October 1-5, 1984, Proceedings. Volume 1. Ann Arbor, MI, Environmental Research Institute of Michigan, 1985, p. 55-59.

Extracting topographic models from digital imagery requires locating all possible conjugate image points in a stereo pair. This is usually accomplished in a computer environment by a correlation algorithm that employs a fixed window size. Matching success depends on strong local contrast and may suffer due to the fact that all image phenomena are treated equally. An optimal approach to image matching may be an algorithm whose window behavior is governed by the variety of image and terrain events present in the stereo pair. A scene-dependent algorithm that handles image phenomena individually by dynamic windowing is described.

Author

A86-21110#

DIGITAL PROCESSING TECHNIQUES FOR IMAGE MAPPING WITH LANDSAT TM AND SPOT SIMULATOR DATA

P. S. CHAVEZ, JR. (U.S. Geological Survey, Flagstaff, AZ) IN: International Symposium on Remote Sensing of Environment, 18th, Paris, France, October 1-5, 1984, Proceedings. Volume 1. Ann Arbor, MI, Environmental Research Institute of Michigan, 1985, p. 101-116. refs

To overcome certain problems associated with the visual selection of Landsat TM bands for image mapping, the author used a quantitative technique that ranks the 20 possible three-band combinations based upon their information content. Standard deviations and correlation coefficients can be used to compute a value called the Optimum Index Factor (OIF) for each of the 20 possible combinations. SPOT simulator images were digitally processed and compared with Landsat-4 Thematic Mapper (TM) images covering a semi-arid region in northern Arizona and a highly vegetated urban area near Washington, D.C. Statistical comparisons indicate that more radiometric or color information exists in certain TM three-band combinations than in the three SPOT bands. The image data were also subjected to high-pass spatial filtering with a percent of the original image added to the

results, which allowed local detail to be enhanced in dark and bright regions while preserving brightness relationship along the various cover types. This combined with digital enlargement and low-pass filtering generated products useful for image mapping.

Author

A86-21140#

THE INTERPRETATION OF SAR IMAGERY AND THE SCATTERING OF MICROWAVES FROM NATURAL TERRAIN

M. S. SCIVIER, M. A. FIDDY, and R. E. BURGE (King's College, London, England) IN: International Symposium on Remote Sensing of Environment, 18th, Paris, France, October 1-5, 1984, Proceedings. Volume 1. Ann Arbor, MI, Environmental Research Institute of Michigan, 1985, p. 445-452. SERC-supported research. refs

Synthetic aperture radar (SAR), the interpretation of complex image data, and applications to remote sensing are described. In particular, ways in which interpretation may be improved by considering a more sophisticated model for the interaction of microwaves with natural terrain are suggested. The importance of combining theoretical development with the acquisition of actual SAR data is illustrated by reference to the forthcoming Shuttle Imaging Radar (SIR-B) shallow-water experiment.

Author

A86-21141#

STEREOPLOTTING OF SPOT IMAGES USING IGN/MATRA TRASTER SOFTWARE [STEREORESTITUTION D'IMAGES SPOT A L'AIDE DU LOGICIEL TRASTER IGN/MATRA]

C. VIGNERON (Matra, S.A., Bois-d'Arcy, France) and P. DENIS (Institut Geographique National, Saint-Mande, France) IN: International Symposium on Remote Sensing of Environment, 18th, Paris, France, October 1-5, 1984, Proceedings. Volume 1. Ann Arbor, MI, Environmental Research Institute of Michigan, 1985, p. 455-464. In French.

The French National Geographical Institute has developed software for the stereoscopic plotting of nonconventional images adapted to the MATRA TRASTER analytical stereoplotter. Two of the softwares are currently operational: one for underwater images (BATHY), the other for satellite images (SPOT). First results of the simulation of SPOT images for topographic and thematic mapping are given.

B.J.

A86-21146#

DEVELOPMENT OF DIGITAL IMAGE PROCESSING IN A DEVELOPING COUNTRY - A CASE STUDY FROM PAPUA NEW GUINEA

F. R. HONEY (Geoscan Pty., Ltd., West Perth, Australia), K. J. LYONS (Queensland, University, Brisbane, Australia), and G. L. WRIGHT (Western Australian Institute of Technology, Bentley) IN: International Symposium on Remote Sensing of Environment, 18th, Paris, France, October 1-5, 1984, Proceedings. Volume 1. Ann Arbor, MI, Environmental Research Institute of Michigan, 1985, p. 511-520. refs

The aim of the project was to develop, at a reasonable cost, an analysis system capable of analyzing digital images, and to assess its potential for mapping and environmental assessment in the Papua New Guinea region. Access to a PDP 11/34 computer was available through the Department of Surveying at the Papua New Guinea University of Technology. Australian Government aid enabled development of software to process Landsat data, with output produced by a lineprinter. The results from pilot studies were sufficiently encouraging to justify capital expenditure on a digital image processing capability. The paper describes the processing and display system, and highlights the capabilities of the system for use in environmental surveys. The basic system allowed, for the first time, the evaluation of digital remote sensor data in Papua New Guinea. It enabled development of expertise within the country and encouraged Papua New Guinea nationals to participate in developing techniques for solution of remote sensing tasks specific to their country.

Author

A86-21153#

GEOSCIENCE ANALYSES OF LANDSAT IMAGERY - AN IMAGE ATLAS OF CHINA

S. CHENG, X. HUANG, H. LI (Chinese Academy of Sciences, Institute of Remote Sensing Application, Beijing; National Remote Sensing Centre, People's Republic of China), and C. ZHENG (Chinese Academy of Sciences, Institute of Geography, Beijing, People's Republic of China) IN: International Symposium on Remote Sensing of Environment, 18th, Paris, France, October 1-5, 1984, Proceedings. Volume 1. Ann Arbor, MI, Environmental Research Institute of Michigan, 1985, p. 575-579.

The Atlas is a review of developments in the application of Landsat imagery to geoscience analysis in China. The contents of the Atlas reflect concepts and understandings of geosciences derived from the Landsat imagery. The Atlas concentrates on four themes: land cover and land use, hydrological dynamic phenomena, regional characters of landform, and lineament of geological structure. For each typical area, an interpretation map and an explanation were given along with a false color image composite from MSS. Twelve reference maps of country-wide analysis results of basic rules of distribution of physical geographic elements were collected, to help understand significance effects in the evolution of physical history, in the protection of ecological environment, and in the exploration of natural resources of China. Author

A86-21165*# Environmental Research Inst. of Michigan, Ann Arbor.

A SPECTRAL HAZE DIAGNOSTIC FEATURE FOR NORMALIZING LANDSAT THEMATIC MAPPER DATA

E. P. CRIST (Michigan, Environmental Research Institute, Ann Arbor) IN: International Symposium on Remote Sensing of Environment, 18th, Paris, France, October 1-5, 1984, Proceedings. Volume 2. Ann Arbor, MI, Environmental Research Institute of Michigan, 1985, p. 735-744. refs (Contract NAS9-16538)

The effects of atmospheric haze on Thematic Mapper data, transformed to TM Tasseled Cap features, are illustrated by means of simulation. A spectral feature by which the amount of atmospheric haze may be inferred is derived and described for both simulated and actual TM data. Results presented for two actual TM scenes illustrate the diagnostic feature's sensitivity to changes in haze level as well as its insensitivity to scene-class-related variability. The method by which such a diagnostic feature might be incorporated into a haze normalization procedure is also discussed. Author

A86-21171#

DIGITAL ELEVATION MODELING WITH LANDSAT-3 RBV DATA

R. SIMARD (Canada Centre for Remote Sensing, Ottawa, Canada), R. J. OLIVIER, and E. PINA (Lausanne, Universite, Switzerland) IN: International Symposium on Remote Sensing of Environment, 18th, Paris, France, October 1-5, 1984, Proceedings. Volume 2. Ann Arbor, MI, Environmental Research Institute of Michigan, 1985, p. 825-834. refs

Improved results are presented in the use of digital stereo image processing techniques to effectively extract relief information to a good accuracy relative to available parallax information measured in pixel units. Digital Landsat-3 RBV data were used that were acquired over the Swiss Alps, in the mountainous Fribourg region. A mean difference of 9 m with a 41-m standard deviation between elevations obtained from the RBV data and those from accurate topographic maps has been measured. D.H.

A86-21180#

THE STATUS AND FUTURE OF SATELLITE IMAGE MAPPING BASED ON EXPERIENCE OF THE U.S. GEOLOGICAL SURVEY

A. P. COLVOCORESSES (U.S. Geological Survey, Reston, VA) IN: International Symposium on Remote Sensing of Environment, 18th, Paris, France, October 1-5, 1984, Proceedings. Volume 2. Ann Arbor, MI, Environmental Research Institute of Michigan, 1985, p. 957-960.

Three fundamental forms of maps are recognized herein. They are the line, thematic, and image form. Line and thematic maps are well defined but the image map is in a state of flux. Space systems now provide data in basically orthographic form which greatly simplifies the production of the image map. Moreover, the multispectral capability of space systems facilitates the use of the color mode when compared to aerial photography. Digital graphical information systems are now being developed on a global basis and the response from space which represents the image in multispectral form will undoubtedly be incorporated into such information systems. Thus, the capability of printing out the image along with more conventional map data will be a viable option.

Author

A86-21199#

SPOT STEREOSCOPIC IMAGING - IMPLANTATION AND APPLICATIONS (LA STEREOSCOPIE AVEC SPOT - MISE EN OEUVRE ET APPLICATIONS)

H. GUICHARD (Spot Image, S.A., Toulouse, France) IN: International Symposium on Remote Sensing of Environment, 18th, Paris, France, October 1-5, 1984, Proceedings. Volume 2. Ann Arbor, MI, Environmental Research Institute of Michigan, 1985, p. 1177-1188. In French.

A theoretical study of SPOT-satellite stereoscopic imaging is presented. Particular attention is given to a mathematical study of the mapping potential of SPOT; scene simulation; and rectification and plotting by spatial-triangulation segments. First results are presented. B.J.

A86-21202#

RECTIFICATION OF LANDSAT-4 THEMATIC MAPPER IMAGES WITHOUT CORRECTION DATA

A. H. BENNY (Royal Aircraft Establishment, Farnborough, England) IN: International Symposium on Remote Sensing of Environment, 18th, Paris, France, October 1-5, 1984, Proceedings. Volume 2. Ann Arbor, MI, Environmental Research Institute of Michigan, 1985, p. 1245-1250.

The scan lines of Landsat-4 Thematic Mapper images suffer a variable relative displacement due to small variations in the scan-mirror velocity. The planned provision of information about the mirror movements did not occur for some otherwise valuable images. This paper describes a method for rectifying these images. Author

A86-21203*# Environmental Research Inst. of Michigan, Ann Arbor.

INFORMATION THEORETIC COMPARISONS OF ORIGINAL AND TRANSFORMED DATA FROM LANDSAT MSS AND TM

W. A. MALILA (Michigan, Environmental Research Institute, Ann Arbor) IN: International Symposium on Remote Sensing of Environment, 18th, Paris, France, October 1-5, 1984, Proceedings. Volume 2. Ann Arbor, MI, Environmental Research Institute of Michigan, 1985, p. 1251-1262. refs (Contract NAS5-27346)

The dispersion and concentration of signal values in transformed data from the Landsat-4 MSS and TM instruments are analyzed using a communications theory approach. The definition of entropy of Shannon was used to quantify information, and the concept of mutual information was employed to develop a measure of information contained in several subsets of variables. Several comparisons of information content are made on the basis of the information content measure, including: system design capacities; data volume occupied by agricultural data; and the information content of original bands and Tasseled Cap variables. A method

for analyzing noise effects in MSS and TM data is proposed.

I.H.

A86-21209#

EVALUATION OF TOPOGRAPHIC PROFILES AND GEOMETRIC RECTIFICATION ON A SEASAT SAR IMAGE

J. Y. GARINET (IBM France S.A., Paris, France) and R. JEANSOULIN (Institut National de Recherche en Informatique et en Automatique, Le Chesnay, France) IN: International Symposium on Remote Sensing of Environment, 18th, Paris, France, October 1-5, 1984, Proceedings. Volume 3. Ann Arbor, MI, Environmental Research Institute of Michigan, 1985, p. 1333-1341. refs

A geometric rectification is required in the case of any study which uses images from different sources. The rectification procedure can become difficult, or even impossible, if areas with reliefs are involved. The arising problems are caused by the strong distortions which are produced in connection with the specific principle of the image formation employed in the case of a Synthetic Aperture Radar (SAR). The formation of a radar image is discussed along with details regarding the occurring geometric radar image distortions. Two approaches for achieving geometric correction are proposed. In a first step, a method of rectification based on the use of a digital terrain model (DTM) can be employed, while a second step involves the evaluation of topographic profiles. G.R.

A86-21218#

REGISTRATION AND CLASSIFICATION OF SIR-A, SEASAT AND LANDSAT MSS DATA OVER MONASTIR (TUNISIA)

PH. REBILLARD, P. N. PASCAUD (Societe Europeenne de Propulsion, Division de Traitement d'Images, Puteaux, France), H. HARRAN, and J. CHOROWICZ (Paris VI, Universite, France) IN: International Symposium on Remote Sensing of Environment, 18th, Paris, France, October 1-5, 1984, Proceedings. Volume 3. Ann Arbor, MI, Environmental Research Institute of Michigan, 1985, p. 1433-1441. refs

An area located in northern Tunisia has been surveyed by both Seasat and SIR-A providing perpendicular radar illumination directions. The radar images are contrasted with the Landsat MSS images overlapping the same area. The synthetic aperture radar data were acquired in 1978 by Seasat and in 1981 by the shuttle imaging radar. The Landsat pictures were taken in 1978 and 1981. In this study, subareas of the SIR-A and MSS images are registered to the corresponding Seasat data. The test site is a 60 km by 40 km wide area which displays two playas. It is a low relief area with subdesertic climatic conditions. Registering multispectral and multitemporal data enables comparisons between the systems (radar vs MSS, and Seasat vs SIR-A), and changes detection in the desertification processes and on the surface of the playas. An unsupervised classification has been performed over the coregistered image data set. It clearly shows the strong boundary between the coastal plain and the subdesertic inland. Author

A86-21224#

A CONCEPT OF MULTI-SPECTRAL IMAGE DATA WITH ANALYTICAL PROGRAM STORED IN FLOPPY DISKET

T. SAKAI, K. SEYA, H. NISHIKAWA, J. OSHIMA (College of Industrial Technology, Narashino, Japan), and T. SUGIMURA (Remote Sensing Technology Center of Japan, Tokyo) IN: International Symposium on Remote Sensing of Environment, 18th, Paris, France, October 1-5, 1984, Proceedings. Volume 3. Ann Arbor, MI, Environmental Research Institute of Michigan, 1985, p. 1499-1506.

This paper addresses a concept of multi-spectral image data with analysis program, in today's circumstances. If remotely sensed image data in a limited area are chosen and some analysis programs are attached together with the data, the user will instantaneously approach the utilization of the data by the desktop computer system. The authors construct a Landsat MSS data and a NOAA/AVHRR multi-spectral data of small area with some analysis function programs, and then store them in a 8 inch floppy disk. The image data stored in one floppy disk are constructed 400 lines by 512 pixels with 4 bands. The programs are written in BASIC of NEC PC-9801. This program can be easily transferred

to the other computer models. An example of the utilization of this type of data was in laboratory for fishery in Japan, and may be further acceptable in the fields of natural environmental managements. Author

A86-21228#

PRINCIPLES FOR THE PROGRAMMING OF SPOT SATELLITE IMAGES [PRINCIPES DE PROGRAMMATION DES IMAGES DU SATELLITE SPOT]

B. CABRIERES, A. CARIOU, and G. PONCE (CNES, Toulouse, France) IN: International Symposium on Remote Sensing of Environment, 18th, Paris, France, October 1-5, 1984, Proceedings. Volume 3. Ann Arbor, MI, Environmental Research Institute of Michigan, 1985, p. 1533-1539. In French.

The role of the SPOT Mission Center in the programming of SPOT images is described. The Center is designed to: (1) choose the satellite configurations that best satisfy user requirements; (2) develop the payload schedule; and (3) inform the user about the scenes acquired. B.J.

A86-21242#

A COMPARISON OF SOME CONTEXTURAL METHODS IN REMOTE SENSING CLASSIFICATION

N. L. HJORT and E. MOHN (Norwegian Computing Center, Oslo, Norway) IN: International Symposium on Remote Sensing of Environment, 18th, Paris, France, October 1-5, 1984, Proceedings. Volume 3. Ann Arbor, MI, Environmental Research Institute of Michigan, 1985, p. 1693-1702. refs

A general formula for the posterior probability of a pixel belonging to a specified class, given the spectral vectors in the pixel and its immediate neighbors, is presented. The formula, involving both the distribution of classes and the distribution of spectral vectors given the classes, gives rise to a variety of contextual methods for the classification of remotely sensed data, all of which aim at a better performance than the classical rules of discriminant analysis that are currently used in most commercial systems. Some earlier published methods are reviewed, and some new procedures proposed. It is argued that the assumption often made that the spectral vectors are spatially uncorrelated given the classes becomes inadequate when applied to small pixels, i.e. high resolution satellites. A preliminary comparison of some of the methods, applied to a simulated SPOT scene in Norway, is included. Author

A86-21248#

THREE-COLOR REPRESENTATIONS OF LANDSAT IMAGES [REPRESENTATIONS TRICHROMIQUES DES IMAGES LANDSAT]

A. LEDUC (Rouen, Universite, Mont-Saint-Aignan, France) IN: International Symposium on Remote Sensing of Environment, 18th, Paris, France, October 1-5, 1984, Proceedings. Volume 3. Ann Arbor, MI, Environmental Research Institute of Michigan, 1985, p. 1751-1758. In French.

The application of the three-color method (involving the superimposition of three primary colors) to the representation of Landsat-2 multispectral images is discussed. Visually significant associations were found to be limited, and channel decorrelation by factorial analysis did not yield the expected results. An analysis of the variability of the main factors via sampling of various windows extracted from Landsat scenes conforms the graphic results. It is concluded that Landsat data do not greatly lend themselves to representation by three-color imagery. This necessitates an improvement of the selectivity of radiometric sensors. B.J.

A86-21250#

MULTITEMPORAL DATA ANALYSIS BY EXTENDED RADIOMETRIC CORRECTION

T. KUSAKA, Y. KAWATA, and S. UENO (Kanazawa Institute of Technology, Ishikawa, Japan) IN: International Symposium on Remote Sensing of Environment, 18th, Paris, France, October 1-5, 1984, Proceedings. Volume 3. Ann Arbor, MI, Environmental Research Institute of Michigan, 1985, p. 1775-1783.

A means is given of treating the problem that a variable direction of solar illumination makes it difficult to analyze multitemporal remote sensing data because CCT level counts vary greatly with illumination angle, which in turn varies with the seasons. An important correlation is noted between variations in band 6 and 7 CCT levels of Landsat multi-spectral scanners (MSS) and the local topographies in mountainous terrain. An approximation method is proposed to reject both the topographic and atmospheric effects from the Landsat MSS data. An application of the proposed method to the data proved that the rejection of the two effects was, to some extent, successfully done in mountainous terrain. D.H.

A86-21251#

DIGITAL MOSAIC PROCESSING

S. HORII, Y. OSHIMA, K. HIRAO (Toshiba Corp., Advanced Space Programs Dept., Kawasaki, Japan), I. KOHNO, and T. YOKOYAMA (Earth Resources Satellite Data Analysis Center, Tokyo, Japan) IN: International Symposium on Remote Sensing of Environment, 18th, Paris, France, October 1-5, 1984, Proceedings. Volume 3. Ann Arbor, MI, Environmental Research Institute of Michigan, 1985, p. 1785-1794. refs

A computer-aided digital processing technique is described that can create a mosaic of Landsat images to cover an expanded area (for oil field exploration or other wide area research). The technique eliminates obtrusive joint lines, yields high-quality images for detailed analysis, and reduces the computing time. D.H.

A86-21253#

EDGE DETECTION PROBLEMS IN A MOUNTAINOUS REGION - APPLICATION TO THE 'ATLAS BLIDEAN'

A. OUSSEDIK, A. KHINECHE, and A. ABDELLAOUI (Conseil de l'Economie Nationale, Centre de Developpement des Techniques Avancees, Algiers, Algeria) IN: International Symposium on Remote Sensing of Environment, 18th, Paris, France, October 1-5, 1984, Proceedings. Volume 3. Ann Arbor, MI, Environmental Research Institute of Michigan, 1985, p. 1803-1813. refs

The problem of edge detection in space imagery of mountainous regions is treated. The Blidean Atlas, a 1630-m mountain oriented east and west in the middle part of the Algiers Tellian chain in Algeria, is chosen as the subject of the investigation. The first general approach is to use space differentiation operators to characterize the edges of major physiographic units, but edges inside shaded slopes cannot be recognized. An edge detection process is proposed using local thresholding; it allows characterization of units in the shaded slopes. D.H.

A86-21267#

LAND USE MAPPING BY REMOTE SENSING IN THE MEDITERRANEAN REGION - DEVELOPMENT OF A SOFTWARE PACKAGE FOR PROCESSING LANDSAT DATA

R. MANIERE (Nice, Universite, France), M. POISSON (SODETEG-Teledetection, Valbonne, France), and M. LECHARPENTIER (Paris, Ecole National Supérieure des Mines, France) IN: International Symposium on Remote Sensing of Environment, 18th, Paris, France, October 1-5, 1984, Proceedings. Volume 3. Ann Arbor, MI, Environmental Research Institute of Michigan, 1985, p. 1937-1944. refs

A fully automatic procedure for land use classification using Landsat is described. By combining unsupervised (CLAMS system) and supervised techniques, the processing method provides optimal results and minimizes operator dependencies in the classification. The procedure is easily repeatable, and can be used to apply the same set of ground truth information to multitemporal imagery. At the same time, it provides a fairly low cost approach to land use inventories by remote sensing. Author

A86-22563

THE INTERCONNECTION BETWEEN THE OPTIMAL NUMBER OF PROCESSED SPECTRA AND THE SPATIAL RESOLUTION OF REMOTE SENSING DEVICES IN OBSERVATIONS OF NATURAL OBJECTS FROM SPACE [VZAIMOSVIAZ' OPTIMAL'NOGO CHISLA OBRABATYVAEMYKH SPEKTROV S PROSTRANSTVENNYM RAZRESHENIEM APPARATURY PRI DISTANTSIONNOM ISSLEDOVANII PRIRODNYKH OB'EKTOV] A. I. IANOVSKII and E. A. IANOVSKAIA (AN BSSR, Institut Fiziki, Minsk, Belorussian SSR) Issledovanie Zemli iz Kosmosa (ISSN 0205-9614), Sept.-Oct. 1985, p. 95-98. In Russian. refs

Criteria are proposed for estimating the spectral homogeneity of natural objects for remote sensing applications. Formulas are obtained for the minimum number of measurements required to calculate the spectral brightness coefficient of the natural object, assuming the spatial resolution of the spectrometer is about 10 percent. The application of the formulas to Multispectral Scanner (MSS) imagery is discussed in detail. I.H.

A86-22826

SPOT SIMULATION APPLICATIONS HANDBOOK; PROCEEDINGS OF THE SPOT SYMPOSIUM, SCOTTSDALE, AZ, MAY 20-23, 1984

Symposium sponsored by ASP and CNES. Falls Church, VA, American Society of Photogrammetry, 1984, 298 p. For individual items see A86-22827 to A86-22835, A86-22837 to A86-22853.

The SPOT satellite system is discussed, taking into account the organization and data distribution policy related to the SPOT program, the SPOT system conception and project status, SPOT simulation campaign methodology, approaches for insuring a mosaic with revisit flexibility capabilities, and the testing of SPOT satellite acquisition strategies over the U.S. Applications related to geology are examined, giving attention to an evaluation of SPOT simulator data for geologic mapping in the split mountain region, digital processing of SPOT simulator and Landsat TM data for the SP mountain region, evaluation of SPOT simulator data for the detection of alteration in Goldfield/Cuprite, preliminary evaluation of simulated SPOT data for cultural resource assessment, a review of SPOT imagery simulation at the Copper Canyon Cu-Au mining area, and new digital elevation mapping software applied to SPOT simulation stereo data. Other topics explored are related to agriculture, urban planning and cartography, water resources and environmental applications, and forestry. G.R.

A86-22829

SPOT SIMULATION METHODOLOGY - SIMULATED VS. SATELLITE IMAGE PARAMETERS

G. SAINT (CNES, Toulouse, France) and G. WEILL (SPOT Image Corp., Washington, DC) IN: SPOT simulation applications handbook; Proceedings of the SPOT Symposium, Scottsdale, AZ, May 20-23, 1984. Falls Church, VA, American Society of Photogrammetry, 1984, p. 19-28.

The paper summarizes the technical background of the 1983 U.S. SPOT Simulation Data; it discusses the calibration, data acquisition and ground processing procedures through which deliverable digital products were realized. The likenesses of the simulation data to the anticipated radiometric and geometric properties of the satellite data are then discussed, and potential discrepancies are outlined. Most primary parameters which were to be simulated were well met. Author

A86-22830

ENSURING A MOSAIC WITH REVISIT FLEXIBILITY CAPACITIES

G. PONCE (CNES, Toulouse, France) IN: SPOT simulation applications handbook; Proceedings of the SPOT Symposium, Scottsdale, AZ, May 20-23, 1984. Falls Church, VA, American Society of Photogrammetry, 1984, p. 29-36.

The cross-track viewing capability can be used to increase the number of opportunities to image a precise point and reduce time needed to get a complete mosaic of a vast area. However the problem of ensuring a complete mosaic with all of the images realized on the area becomes more difficult when using this

capability, because image strips realized with different viewing angles have different orientations on the ground. The presentation introduces this problem as well as the method used to solve it. The basic organization set up to take into account the solution is described and the method used to choose between all the possible viewing angles for a given orbital pass is also depicted. Author

A86-22851**DIGITAL TERRAIN MODEL SYNTHESIS USING SIGNAL MATCHING IN NATURALLY VEGETATED REGIONS**

R. R. IRISH, A. H. STRAHLER (Hunter College, New York), and A. ABIODUM (United Nations, Outer Space Affairs Div., New York) IN: SPOT simulation applications handbook; Proceedings of the SPOT Symposium, Scottsdale, AZ, May 20-23, 1984. Falls Church, VA, American Society of Photogrammetry, 1984, p. 241-250. refs

Extracting topographic models from digital imagery requires locating all possible conjugate image points in a stereopair. This is usually handled by signal matching - a process by which an array of pixels surrounding a point in one image is sequentially compared to a series of equivalently sized subsets comprising a larger array in the second image. Matching success depends on several factors. These include the array window size and degree of local image contrast caused by viewing geometry and feature reflectance. A simulated SPOT stereopair, collected over a naturally vegetated region and lacking in any major cultural features, is processed by signal matching using array windows of increasing size. Results support the need for an algorithm that dynamically adjusts itself to changing image phenomena. Author

A86-22852**SPOT POTENTIAL FOR LAND USE/LAND COVER CLASSIFICATION IN USING IMAGE ENHANCEMENT AND COMPUTER PROCESSING**

J. H. ROEBIG (Tippetts-Abbett-McCarthy-Stratton, New York), E. HARDY, R. BRYANT (Cornell University, Ithaca, NY), and B. GUETTI (New York State, Dept. of Environmental Conservation, Albany) IN: SPOT simulation applications handbook; Proceedings of the SPOT Symposium, Scottsdale, AZ, May 20-23, 1984. Falls Church, VA, American Society of Photogrammetry, 1984, p. 251-258. refs

Three principal investigators have tested the ability of SPOT simulation data to provide the LUNR and National Land Use/Land Cover classification systems categories of information. The methods involve: (1) direct interpretation of categories from 1:24,000 scale false color composite print with special consideration for its potential in mapping vegetation and wetlands; (2) examination of a low-cost Diazo process in making negatives from which color composites can be prepared for use in various forms; and (3) computer processing of simulated data using both supervised and unsupervised classification methods on the Earth Resources Data Analysis System. Author

A86-25485**ADAPTIVE BAYESIAN CLASSIFICATION OF MULTISPECTRAL IMAGES OF THE EARTH [ADAPTIVNAIA BAIISOVSKAIA KLASSIFIKATSIYA MNOGOZONAL'NYKH IZOBRAZHENII POVERKHNOSTI ZEMLI]**

A. M. CHIZHEVSKII (Institut Soizugiprovodkhoz, Moscow, USSR) Issledovanie Zemli iz Kosmosa (ISSN 0205-9614), Nov.-Dec. 1985, p. 60-65. In Russian. refs

An adaptive method for the computer-aided classification of multispectral images of the earth's surface is proposed which is based on the division of the decision-making procedure into three levels of increasing complexity. When a decision is made at a lower level, no calculations at a higher level are required. Compared with a conventional Bayesian classifier based on calculated a posteriori probabilities or their logarithms, the proposed method reduces the recognition time requirement by a factor of 2 to 4 with no loss of accuracy. B.J.

A86-25595**HOLOGRAPHIC RECOGNITION DEVICES [GOLOGRAFICHESKIE RASPOZNAUSHCHIE USTROISTVA]**

G. I. VASILENKO and L. M. TSIBULKIN Moscow, Izdatel'stvo Radio i Sviaz', 1985, 312 p. In Russian. refs

After a review of statistical methods of pattern recognition and the principles of optical data processing, the present work examines the use of holography for pattern recognition. Methods for the development of various types of holographic filters are examined along with factors affecting the reliability of pattern recognition by means of holographic correlators. Particular attention is given to the application of holographic recognition devices in such fields as robot technology, hybrid optoelectronic computing, the processing of remote-sensing data, and spacecraft navigation. B.J.

A86-26316**TEXTURAL INFORMATION IN SAR IMAGES**

F. T. ULABY, F. KOUYATE (Michigan, University, Ann Arbor), B. BRISCO, and T. H. L. WILLIAMS (Kansas, University, Lawrence) IEEE Transactions on Geoscience and Remote Sensing (ISSN 0196-2892), vol. GE-24, March 1986, p. 235-245. refs

Image variance for a given land use category is presently related to individual variances associated with image speckle and target texture by means of a multiplicative model; in it, speckle is treated as a random process governed by signal fading, that is independent of the textural variations associated with scattering property spatial variations in visually uniform 'distributed' targets. Seasat SAR imagery of Oklahoma was used to evaluate the textural autocorrelation function of water, forest, pasture, urban, and cultivated land use categories. It is found that the image contrast and inverse moment second-order statistics furnished a classification accuracy of 88 percent, with only modest spatial resolution degradation. A second study based on SIR-A imagery of five forested regions shows that the use of textural data can improve classification accuracy from 75 to 93 percent. Author

A86-26693**A COEFFICIENT OF AGREEMENT AS A MEASURE OF THEMATIC CLASSIFICATION ACCURACY**

G. H. ROSENFELD and K. FITZPATRICK-LINS (USGS, Reston, VA) Photogrammetric Engineering and Remote Sensing (ISSN 0099-1112), vol. 52, Feb. 1986, p. 223-227. refs

The use of the Cohen (1960) Kappa coefficient of agreement to measure total map accuracy and the conditional Kappa to measure individual category accuracy is examined. The development of the Kappa coefficient, its variance, and tests for significant differences are reviewed. The classification error matrices for two photointerpreters computed by Congalton and Mead (1983) by applying the Kappa coefficient of agreement are presented. The Kappa coefficient values and variances are calculated for individual categories of the photointerpreters and compared with percent correct values. The accuracy indices of Turk (1979), Hellden (1980), and Short (1982) used to evaluate the individual category accuracy of remote sensing data are described. These methods and percent correct values are compared with conditional Kappa coefficient values; it is observed that the percent correct values overestimate classification accuracy and the accuracy indices underestimate the classification accuracy when compared to Kappa data. I.F.

N86-16698# California Univ., Davis. Signal and Image Processing Lab.

A TUTORIAL ON CREATING A GRID CELL LAND COVER DATA FILE FROM REMOTE SENSING DATA Final Report

G. E. FORD, D. I. MEYER, and V. R. ALGAZI Jun. 1985 78 p (Contract DACW05-83-C-0112) (AD-A159365; SIPL-85-4; SIPL-TD-22) Avail: NTIS HC A05/MF A01 CSCL 09B

This document describes the procedures involved in linking a remote sensing system and a spatial data management system. Specifically, it identifies and describes a sequence of steps for the classification of LANDSAT multispectral scanner (MSS) data

and the creation of a grid cell land cover data file. The resulting grid cell file can be merged into a Hydrologic Engineering Center (HEC) Spatial Analysis Methodology (SAM) spatial database. The procedures are also applicable to remote sensing data acquired from other sensor systems. The presentation is intended for those who are familiar with the SAM system and the characteristics and potential of remote sensor image data. Author (GRA)

N86-18384# Centre National d'Etudes Spatiales, Toulouse (France).

GEOMETRIC RECTIFICATION AND PHOTOGRAMMETRIC RECONSTRUCTION OF SPOT IMAGES [RECTIFICATION GEOMETRIQUE ET RESTITUTION PHOTOGRAMMETRIQUE DES IMAGES SPOT]

H. GUICHARD *In* ESA Proceedings of EARSeL/ESA Symposium on European Remote Sensing Opportunities: Systems, Sensors, and Applications p 229-233 Jun. 1985 *In* FRENCH

Avail: NTIS HC A12/MF A01

The use of SPOT satellite imagery for mapping is described. The geometric resolution of SPOT images make them suitable for 1:50,000 scale maps. The mathematical modeling of a scene, and the rectification and triangulation procedures are outlined. Tests on a 600 km long segment (10 scenes) show accuracy better than 10 km, compared to ground truth, using 10 reference points.

Author (ESA)

N86-18597# Army Engineer Topographic Labs., Fort Belvoir, Va.

THIRD-ORDER CO-OCCURRENCE TEXTURE ANALYSIS APPLIED TO SAMPLES OF HIGH RESOLUTION SYNTHETIC APERTURE RADAR IMAGERY Technical Report, Jan. - Jun. 1984

R. A. HEVENOR Aug. 1985 38 p

(Contract DA PROJ. 4A1-61101-A-91-D)

(AD-A160640; ETL-0396) Avail: NTIS HC A03/MF A01 CSCL 171

A third-order co-occurrence texture analysis technique was applied to samples of synthetic aperture radar imagery. This technique was applied to four classes of terrain features on selected samples of radar imagery. The four classes considered were forests, cities, agricultural fields, and water. A fracture vector was computed from samples of each class. A linear feature selection technique was applied for dimensionality reduction, and a pseudo-inverse classifier was developed. This classifier was applied to the original training samples as well as to other samples from the same imagery. GRA

N86-19716# Advanced Information and Decision Systems, Mountain View, Calif.

LINEAR FEATURE EXTRACTION FROM RADAR IMAGERY Final Report, 11 Sep. 1984 - 30 Jun. 1985

D. T. LAWTON, J. GLICKSMAN, G. D. CONNER, and R. J. DRAZOVICH Sep. 1985 149 p

(Contract DACW72-84-C-0014)

(AD-A161154; AI/DS-TR-3075-01; ETL-0405) Avail: NTIS HC A07/MF A01 CSCL 171

This report summarizes a feasibility study performed by AI&DS to determine the requirements for the extraction of linear features such as roads, rivers, and environmental region boundaries from SAR aerial imagery. The effort has involved determining effective processes for extracting such features by algorithm surveys, hand processing sample imagery, and algorithm implementation. This work has provided the necessary basis for the implementation of an intelligent, automated system in Phase 2 of this research. We have designed a general vision system for linear feature extraction which can be generalized to a wide range of SAR (and other sensor) objects, and begun developments of the components of such a system. Author (GRA)

N86-20268# Joint Publications Research Service, Arlington, Va. **DYNAMIC AEROSPACE SENSING (CONTENT, PROBLEMS, FIELD OF APPLICABILITY) Abstract Only**

Y. F. KNIZHNIKOV *In* its USSR Report: Space (JPRS-USP-86-001) p 161-162 13 Jan. 1986 Transl. into ENGLISH from Vestnik Moskovskogo Universiteta, Seriya 5: Geografiya (Moscow, USSR), no. 4, Jul. - Aug. 1985 p 7-13 Avail: NTIS HC A03

Dynamic aerospace sensing is defined as a modern methodology for studying temporal dynamics with the use of aerospace methods. Direct and indirect variants are distinguished, being based on use of a series of photographs taken at different times or on use of individual photographs. Direct methods for the most part supply quantitative information on dynamics, its intensity and rate. The spatial and temporal coverage of the phenomena which can be studied using photographs taken at different times is different. Whereas there are virtually no spatial limitations, the duration of the temporal coverage does not exceed the 11 year, or possibly the bruckner cycle of natural changes. The indirect methods make it possible to study the temporal and spatial dynamics in a case when it is reflected in the external appearance of objects which are indicators of dynamics. The interval of temporal analysis is virtually unlimited. The range of features, phenomena and processes whose dynamics can be studied by aerospace methods is extremely broad and the range of scales is from detailed to global. Nevertheless, they are all based on common methodological principles ensuring a comparability of the results. In the different geographic branches, the level and breadth of development of such studies varies at present. They are particularly promising in meteorology, oceanology, glaciology and hydrology, which deal with mobile objects and phenomena. However, the other geographical sciences, especially dealing with the socioeconomic aspects of geography, can profit greatly from application of the method. Another highly important merit of the method is that it can be applied in the prediction of spatial-temporal changes of features, phenomena and processes; it is useful in expert evaluations, extrapolation and modeling. Author

N86-20453# Joint Publications Research Service, Arlington, Va. **CLASSIFICATION OF NATURAL FORMATIONS BASED ON THEIR OPTICAL CHARACTERISTICS USING SMALL VOLUMES OF SAMPLES Abstract Only**

N. S. ABRAMOVICH, A. A. KOVALEV, and V. Y. PLYUTA *In* its USSR Report: Space (JPRS-USP-86-002) p 70 10 Feb. 1986 Transl. into ENGLISH from Issledovaniye Zemli iz Kosmosa (Moscow, USSR), no. 4, Jul. - Aug. 1985 p 105-111 Original language document was announced in IAA as A86-13288

Avail: NTIS HC A05

A computer algorithm has been developed to classify the spectral bands of natural scenes on Earth according to their optical characteristics. The algorithm is written in FORTRAN-IV and can be used in spectral data processing programs requiring small data loads. The spectral classifications of some different types of green vegetable canopies are given in order to illustrate the effectiveness of the algorithm. I.H.

N86-21972# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (West Germany). Abteilung Fernerkundung.

INVESTIGATION OF THE INFORMATION CONTENT OF LANDSAT THEMATIC MAPPER (TM) AND SPOT MULTIBAND IMAGE DATA USING SIMULATED IMAGE DATA OF THE FREIBURG REGION

W. KIRCHHOFF, W. MAUSER (Freiburg Univ., West Germany), and H. J. STIEBIG (Freiburg Univ., West Germany) Jun. 1985 146 p refs *In* GERMAN; ENGLISH summary Report will also be announced as translation (ESA-TT-975) Original contains color illustrations

(DFVLR-FB-85-49; ISSN-0171-1342) Avail: NTIS HC A07/MF A01; DFVLR, Cologne DM 52

A comparative analysis of information content was performed using data sets with pixel sizes of 10, 20, 30, 50, and 80 m from LANDSAT TM simulation. The discrimination of objects, structures,

and texture, depending on pixel size and combination of spectral bands, was investigated by visual interpretation and supervised classification for applications in agriculture and forestry. The new TM bands produce significant improvements in the separation of vegetated and built-up areas as well as in the delineation of the status of growth and humidity in comparison with LANDSAT MSS. The thematic mapper is eminently suited for the extraction of thematic information of surface areas of 1 hectare or more. Three to four spectral bands are normally sufficient. The information content of 20 m SPOT multiband data does not differ essentially from that of comparable TM bands (TM2, TM3, TM4). A substantial complement to the TM information are structure and texture elements of the panchromatic 10 m SPOT band. Author (ESA)

08

INSTRUMENTATION AND SENSORS

Includes data acquisition and camera systems and remote sensors.

A86-19476

REMOTE SENSING; PROCEEDINGS OF THE MEETING, ARLINGTON, VA, MAY 1, 2, 1984

P. N. SLATER, ED. (Arizona, University, Tucson) Meeting sponsored by SPIE - The International Society for Optical Engineering and ASP. Bellingham, WA, SPIE - The International Society for Optical Engineering (SPIE Proceedings. Volume 475), 1984, 159 p. For individual items see A86-19477 to A86-19489. (SPIE-475)

The subjects investigated are related to modeling studies, Atmospheric effects and radiometric calibration, marine and geological research, spectral signature studies, agricultural research, information extraction and processing, engineering and mapping considerations, and future prospects. Attention is given to a review of models and measurements of multispectral reflectance by plant canopies with recommendations for future research, electrooptical terrain reflectance modeling, atmospheric effects on remote sensing of surface reflectance, the importance and attainment of accurate absolute radiometric calibration, remote sensing of coastal and ocean properties, and high spectral resolution remote sensing of the land. The remote sensing of vegetation at regional scales is considered along with the remote sensing of vegetation characteristics for farm management, the interpretation of topographic relief from digital multispectral imagery, remote sensing research, mapping the earth from space in the 1980s, and the future of remote sensing according to a viewpoint from industry. G.R.

A86-19480* Arizona Univ., Tucson.

THE IMPORTANCE AND ATTAINMENT OF ACCURATE ABSOLUTE RADIOMETRIC CALIBRATION

P. N. SLATER (Arizona, University, Tucson) IN: Remote sensing; Proceedings of the Meeting, Arlington, VA, May 1, 2, 1984. Bellingham, WA, SPIE - The International Society for Optical Engineering, 1984, p. 34-40. refs (Contract NAG5-196; USDA-12-14-5001-38)

The importance of accurate absolute radiometric calibration is discussed by reference to the needs of those wishing to validate or use models describing the interaction of electromagnetic radiation with the atmosphere and earth surface features. The in-flight calibration methods used for the Landsat Thematic Mapper (TM) and the Systeme Probatoire d'Observation de la Terre, Haute Resolution visible (SPOT/HRV) systems are described and their limitations discussed. The questionable stability of in-flight absolute calibration methods suggests the use of a radiative transfer program to predict the apparent radiance, at the entrance pupil of the sensor, of a ground site of measured reflectance imaged through a well characterized atmosphere. The uncertainties of such a method are discussed. Author

A86-19491* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

MULTIBAND SELECTION DEVICE

H. L. RICHARD (NASA, Goddard Space Flight Center, Greenbelt, MD), A. M. MIKA, and R. O. DAVIS (Santa Barbara Research Center, Goleta, CA) IN: Recent advances in civil space remote sensing; Proceedings of the Meeting, Arlington, VA, May 3, 4, 1984. Bellingham, WA, SPIE - The International Society for Optical Engineering, 1984, p. 2-8. refs

Current science projections for future earth-imaging instruments indicate the need for as many as 25 spectral bands, with bandwidths as narrow as 20 nanometers. The desire for a multiplicity of bands has led researchers to study various spectrally dispersive instrument designs as a means of providing the desired future capability. These instrument designs, however, are costly, complex, and of high technical risk. This paper describes a 'multiband selection device' containing several spectral filters that can be placed at the exit faces of a broadband multipoint beam splitter and thereby provide a multiplicity of spectral bands with a high degree of spatial coregistration while utilizing state-of-the-art linear array detectors. Fabrication of the multiband selection device has been successfully accomplished, and the design and test results are described. Author

A86-19492* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

THE LINEAR ARRAY MULTI-BAND SELECTION DEVICE ROLE IN REMOTE-SENSING INSTRUMENT DESIGN

E. E. SPEAKER (NASA, Goddard Space Flight Center, Greenbelt, MD) IN: Recent advances in civil space remote sensing; Proceedings of the Meeting, Arlington, VA, May 3, 4, 1984. Bellingham, WA, SPIE - The International Society for Optical Engineering, 1984, p. 9-12. (Contract NAS5-27173)

A figure-of-merit parameter for the scientific utility of multispectral linear array (MLA) instruments for civil remote sensing is presented. The number of spectral band-pair choices available to the user of a given MLA instrument is proposed as a useful measure of the flexibility and overall utility of that particular instrument design. The multiband selection device capability is analyzed mathematically, and a basis for a cost-benefit comparison of alternative multispectral instrument designs is provided. B.J.

A86-19493* Santa Barbara Research Center, Goleta, Calif.

OPTICAL-SYSTEM DESIGN FOR NEXT-GENERATION PUSHBROOM SENSORS

A. M. MIKA (Santa Barbara Research Center, Goleta, CA) and H. L. RICHARD (NASA, Goddard Space Flight Center, Greenbelt, MD) IN: Recent advances in civil space remote sensing; Proceedings of the Meeting, Arlington, VA, May 3, 4, 1984. Bellingham, WA, SPIE - The International Society for Optical Engineering, 1984, p. 13-23. refs

Next-generation pushbroom sensors for earth observation require high-performance optics that provide high spatial resolution over wide fields of view. Specifically, blur diameters on the order of 10 to 15 microns are needed over 5 to 15 deg fields. In addition to this fundamental level of optical performance, other characteristics, such as spatial coregistration of spectral bands, flat focal plane, telecentricity, and workable pupil location are significant instrument design considerations. The detector-assembly design, optical line-of-sight pointing method and sensor packaging all hinge on these secondary attributes. Moreover, the need for broad spectral coverage, ranging from 0.4 to 12.5 microns, places an additional constraint on optical design. This paper presents alternative design forms that are candidates for wide-field pushbroom sensors, and discusses the instrument-design tradeoffs that are linked to the selection of these alternate optical approaches. Author

A86-19494* RCA Advanced Technology Labs., Camden, N. J.
VISIBLE AND SHORTWAVE INFRARED FOCAL PLANES FOR REMOTE SENSING INSTRUMENTS

J. R. TOWER, B. M. MCCARTHY, L.-E. PELLON, R. T. STRONG (RCA Advanced Technology Laboratories, Camden, NJ), H. ELABD (RCA Laboratories, Princeton, NJ) et al. IN: Recent advances in civil space remote sensing; Proceedings of the Meeting, Arlington, VA, May 3, 4, 1984. Bellingham, WA, SPIE - The International Society for Optical Engineering, 1984, p. 24-33. NASA-supported research. refs

The development of solid-state sensor technology for multispectral linear array (MLA) instruments is described. A buttable four-spectral-band linear-format CCD and a buttable two-spectral-band linear-format short-wave IR CCD have been designed, and first samples have been demonstrated. In addition, first-sample four-band interference filters have been fabricated, and hybrid packaging technology is being developed. Based on this development work, the design and construction of focal planes for a Shuttle sortie MLA instrument have begun. This work involves a visible and near-IR focal plane with 2048 pixels x 4 spectral bands and a short-wave IR focal plane with 1024 pixels x 2 spectral bands. B.J.

A86-19502

USE OF SATELLITE DATA IN OPERATIONAL NUMERICAL WEATHER PREDICTION

R. E. KISTLER and R. D. MCPHERSON (NOAA, National Meteorological Center, Washington, DC) IN: Recent advances in civil space remote sensing; Proceedings of the Meeting, Arlington, VA, May 3, 4, 1984. Bellingham, WA, SPIE - The International Society for Optical Engineering, 1984, p. 92-99. refs

The place of remotely sensed data in the historical perspective of the evolution of operational numerical weather prediction since its inception in 1955 is described. This is followed by a discussion of the remotely sensed components of the global data base in terms of the number of reports from each source, their distribution and availability, and their characteristics and error structure. In addition, an optimum interpolation objective analysis method is developed with emphasis on the treatment of remotely sensed data. Finally, challenges posed by new observing systems are considered. B.J.

A86-19503

REAL TIME METEOROLOGICAL APPLICATIONS OF THE GEOSTATIONARY SATELLITE SOUNDER ON GOES-6 - BATTILING THE COMPUTER, CODE AND CLOCK

C. M. HAYDEN (NOAA, National Environmental Satellite, Data, and Information Service, Madison, WI) and A. J. SCHREINER (NOAA, Space Science and Engineering Center, Madison, WI) IN: Recent advances in civil space remote sensing; Proceedings of the Meeting, Arlington, VA, May 3, 4, 1984. Bellingham, WA, SPIE - The International Society for Optical Engineering, 1984, p. 100-107. refs

From the beginning of December 1983 through mid-February 1984 the Cooperative Institute for Meteorological Satellite Studies (CIMSS) carried out an exercise to deliver temperature and moisture profiles, derived from the GOES-6 VISSR Atmospheric Sounder (VAS), to the National Meteorological Center (NMC) in time for input to the operational forecast at 1330 GMT. The purpose was to provide meteorological data coverage over the data sparse eastern Pacific (EPAC) where timely polar orbiting satellite data are not available. Although a product was delivered only 40 percent of the time, the experiment successfully demonstrated the feasibility of a totally automated VAS retrieval procedure. Data reliability achieved at the EPAC scale appears to be good, though lack of independent verification data requires that forecast impact studies delineate their ultimate value. Author

A86-19504* National Aeronautics and Space Administration: Goddard Space Flight Center, Greenbelt, Md.

REVIEW OF EXPERIMENTS ON THE IMPACT OF SATELLITE DATA ON NUMERICAL WEATHER PREDICTION

R. ATLAS, E. KALNAY, and M. HALEM (NASA, Goddard Space Flight Center, Greenbelt, MD) IN: Recent advances in civil space remote sensing; Proceedings of the Meeting, Arlington, VA, May 3, 4, 1984. Bellingham, WA, SPIE - The International Society for Optical Engineering, 1984, p. 108-115. refs

A brief review is presented of simulation studies and real data experiments which were conducted to assess the impact of satellite observations on numerical weather prediction. These experiments show that while there has been some redundancy between observing systems, satellite data has made significant contributions toward improving global forecasting. Author

A86-19505

RESULTS OF EXPERIMENTAL NUMERICAL FORECASTS USING TEMPERATURE PROFILES FROM GEOSTATIONARY SATELLITES

E. A. OLENIC (NOAA, National Meteorological Center, Washington, DC) IN: Recent advances in civil space remote sensing; Proceedings of the Meeting, Arlington, VA, May 3, 4, 1984. Bellingham, WA, SPIE - The International Society for Optical Engineering, 1984, p. 116-121. refs

A86-19507

WINDSAT - A CONCEPT FOR GLOBAL WIND MEASUREMENT BY INFRARED DOPPLER LIDAR

R. M. HUFFAKER and F. F. HALL, JR. (NOAA, Wave Propagation Laboratory, Boulder, CO) IN: Recent advances in civil space remote sensing; Proceedings of the Meeting, Arlington, VA, May 3, 4, 1984. Bellingham, WA, SPIE - The International Society for Optical Engineering, 1984, p. 129-140. refs

A detailed computer simulation of the Windsat global wind measuring process has been developed and used to establish error limits as a function of design parameters. Studies were conducted for a Windsat research system in a 300 km and an 800 km orbit. Wind measuring errors were less than 2 m/s in the troposphere for the recommended set of parameters. The results indicate the feasibility of measuring global winds from a space platform using a Doppler laser radar. Author

A86-19545

OPTICAL PAYLOAD ACCOMMODATION ON A SPACE STATION

F. C. RUNGE (McDonnell Douglas Astronautics Co., Huntington Beach, CA) IN: The National Symposium and Workshop on Optical Platforms, Huntsville, AL, June 12-14, 1984, Proceedings. Bellingham, WA, SPIE - The International Society for Optical Engineering, 1984, p. 204-211.

Installation accommodation being planned for the Space Station for the exterior and interior payload equipment and operations are studied. The use of the Space Station for support of earth/ocean/atmospheric instrument technology is examined. An example of large deployable telescope assembly and extravehicular activities technology developments is presented. The function, equipment, and internal and external accommodations of the Space Station for the space infrared telescope, which is a one-meter class, cryogenically cooled instrument, are described. The development of an advanced X-ray astrophysics facility for X-ray astronomy research is discussed. The utilization of the Space Station for storgae and assembly of a 20-m diameter, multimirror telescope with detector in the infrared and submillimeter range is analyzed. I.F.

A86-20456* Georgia Inst. of Tech., Atlanta.

A TWO-PHOTON LASER-INDUCED FLUORESCENCE FIELD INSTRUMENT FOR GROUND-BASED AND AIRBORNE MEASUREMENTS OF ATMOSPHERIC NO

J. D. BRADSHAW, M. O. RODGERS, S. T. SANDHOLM, S. KESHENG, and D. D. DAVIS (Georgia Institute of Technology, Atlanta) *Journal of Geophysical Research* (ISSN 0148-0227), vol. 90, Dec. 20, 1985, p. 12,861-12,873. Research supported by the Coordinating Research Council. refs
(Contract NAG1-50)

This paper reports on a new two-photon laser-induced fluorescence (TP-LIF) sensor capable of making routine measurements at the few parts per trillion volume level. This direct spectroscopic detection method has been demonstrated to be a reliable instrument while performing both on the ground and in the air. As currently designed it is unique in being 'signal' rather than 'signal-to-noise' limited. The latter characteristic enables the TP-LIF sensor to make atmospheric measurements of NO under environmental conditions that might normally be considered unsuitable for a laser technique. These include clouds, rain, and, in general, high-atmospheric-aerosol loading conditions. Of special interest is the insensitivity of the TP-LIF NO instrument to changes in pressure while operating in the troposphere. This characteristic has enabled this sensor to be used to record real-time altitude profiles of NO. Future improvements should make possible two measurement opportunities: (1) NO flux measurements via the airborne eddy-correlation method and (2) nitrogen isotopic distribution measurements (e.g., (N-15)/(O-16) versus (N-14)/(O-16)) as a means of identifying specific NO(x) sources. Author

A86-20694

DIGITAL IMAGE DISPLAY AND ANALYSIS OF POLAR ORBITING METEOROLOGICAL SATELLITE AVHRR DATA

W. D. MCFARLAND, T. HOTRABHAVANANDA, M. LYON, S. CHEN, and T. W. BARNEY (Missouri-Columbia, University, Columbia) IN: Spatial information technologies for remote sensing today and tomorrow; Proceedings of the Ninth Pecora Symposium, Sioux Falls, SD, October 2-4, 1984. Silver Spring, MD, Institute of Electrical and Electronics Engineers, Inc., 1984, p. 341-345. NOAA-supported research. refs

The Geographic Resources Center (GRC), University of Missouri-Columbia, working in cooperation with the National Oceanic and Atmospheric Administration (NOAA) Assessment and Information Service Center (AISC) has developed display and analysis capabilities for the NOAA-n Meteorological Satellite (Metsat) series of polar orbiting satellites. This research utilizes the Advanced Very High Resolution Radiometer (AVHRR) scanner which was placed on board the later Metsat. Vegetation indices based on various combinations of channels 1 and 2 from the AVHRR show promise for global vegetation monitoring. A data base from April 1982, to the present has been generated of daily and weekly composite image data in a polar stereographic projection (PSG). These data are received weekly at the GRC and processed for quantitative statistics from target areas and for image display. Both RGB and IHS color display formats are used. Quantitative analysis and graphical display of statistics in the form of time series plots has shown promising results. Even at this low spatial resolution the ability to monitor and characterize vegetative stress has been shown. Author

A86-20703* Maryland Univ., College Park.

AN INTERACTIVE TECHNIQUE TO GENERATE DIGITAL ELEVATION DATA USING A VIDICON CAMERA

J. K. SIRCAR and R. M. RAGAN (Maryland, University, College Park) IN: Spatial information technologies for remote sensing today and tomorrow; Proceedings of the Ninth Pecora Symposium, Sioux Falls, SD, October 2-4, 1984. Silver Spring, MD, Institute of Electrical and Electronics Engineers, Inc., 1984, p. 411-418. NASA-USDA-supported research. refs

A technique is proposed for the semi-automatic digitization of topographic maps using a vidicon camera interfaced with a mini-computer system. The required input is a black and white map that shows only contour lines and corresponding elevation

values such as the advance prints of 7.5 minute USGS topographic sheets. A set of image processing algorithms is implemented on an image of the contour map acquired by a vidicon camera. The system developed performs extraction of contour lines, tagging elevation values and subsequent interpolation of elevations to produce, in 5 sec. x 5 sec. intervals of latitude and longitude, digital elevation matrices. The interpolation of elevations for non-contour points is achieved using a steepest descent algorithm. A communications capability allows the final data to be transferred over telephone lines to an off-site unit such as the floppy disk or a micro-computer. Author

A86-21102#

METHODS AND RESULTS OF SPOT SIMULATION STUDIES - AN OVERVIEW [METHODES ET RESULTATS DES SIMULATIONS SPOT - VUE D'ENSEMBLE]

J. L. DIZIER and J. C. FAVARD (Groupeement pour le Developpement de la Teledetection Aerospatiale, Toulouse, France) IN: International Symposium on Remote Sensing of Environment, 18th, Paris, France, October 1-5, 1984, Proceedings. Volume 1. Ann Arbor, MI, Environmental Research Institute of Michigan, 1985, p. 1-15. In French.

The SPOT simulation studies were initiated in 1979, and they are terminated in 1984/85. A description is given of the techniques which are utilized to simulate the images that will be provided by the future satellite. In the simulation operations, use is made of a 10-channel Daedalus scanner which is carried by an aircraft, taking into account flights at altitudes of 3,500 m and 7,000 m. Details regarding the objectives of the simulation program and the involved test sites are considered. The subjects explored are related to geology, mining prospection, cartography, agriculture, land use, forestry, the coastal zone, urban planning, irrigation, rice production forecast, geomorphology, floods and water regulation, the integrated study of a natural area, grazing ranching management, rice cultivation, and coastal sedimentation. The test sites studied are located in France, Senegal, Mali, Niger, Burkina-Faso, Bangladesh, England, Greece, Italy, Germany, Belgium, U.S., Sudan, Kenya, and Zimbabwe. G.R.

A86-21103#

STUDY OF THE SPOT SIMULATIONS OVER WEST AFRICA

A. BERG (CEC, Joint Research Centre, Ispra, Italy) IN: International Symposium on Remote Sensing of Environment, 18th, Paris, France, October 1-5, 1984, Proceedings. Volume 1. Ann Arbor, MI, Environmental Research Institute of Michigan, 1985, p. 17-25. refs

An airborne SPOT simulation campaign was organized at the end of 1981 over four Sahelian countries in West Africa. The 19 simulation flights covered five different themes related to the main problems which confront SAHEL at the present time. These are Land Use and Desertification - Agricultural Resources - Urban Planning - Coastal Environments - Geology and Mineral Resources. The investigation results are summarized and conclusions are drawn about the value of second generation satellites, in this case SPOT, for the future development of remote sensing applications for developing countries. Author

A86-21109*# General Electric Co., Philadelphia, Pa.

GEOMETRIC CORRECTION OF LANDSAT 4 AND 5 THEMATIC MAPPER DATA

E. P. BEYER (GE Valley Forge Space Center, Philadelphia, PA), J. BROOKS (General Electric Co., Space Div., Lanham, MD), and V. V. SALOMONSON (NASA, Goddard Space Flight Center, Greenbelt, MD) IN: International Symposium on Remote Sensing of Environment, 18th, Paris, France, October 1-5, 1984, Proceedings. Volume 1. Ann Arbor, MI, Environmental Research Institute of Michigan, 1985, p. 89-100. refs

Landsat-4 was launched on July 16, 1982, while the launch of Landsat-5 took place on March 1, 1984. The earth-observing instruments employed were the Multispectral Scanner (MSS), which has flown since 1972 on Landsat satellites, and the Thematic Mapper (TM). The TM provides improved spatial radiance and spectral resolution. The improved capabilities of the TM, the use

of different scanning mechanisms relative to the MSS, and the use of a new spacecraft with different mechanical operating characteristics led to a significant challenge in processing the TM and MSS data. The current paper has mainly the objective to present recent results which can provide information regarding the quality of processing as measured against specifications. The results obtained so far for the Thematic Mapper Image Processing System (TIPS), though limited, are found to be quite encouraging as far as the geometric processing of the TM is concerned.

G.R.

A86-21113#

REPORT ON AN ORBITAL MAPPING SYSTEM

A. P. COLVOCORESSES (U.S. Geological Survey, National Center, Reston, VA) IN: International Symposium on Remote Sensing of Environment, 18th, Paris, France, October 1-5, 1984, Proceedings. Volume 1. Ann Arbor, MI, Environmental Research Institute of Michigan, 1985, p. 139-143. refs

During June 1984, the International Society for Photogrammetry and Remote Sensing accepted a committee report that defines an Orbital Mapping System (OMS) to follow Landsat and other earth-sensing systems. The OMS involves the same orbital parameters of Landsats 1, 2, and 3, three wave bands (two in the visible and one in the near infrared) and continuous stereoscopic capability. The sensors (3) involve solid-state linear arrays and data acquisition (including stereo) designed for one-dimensional data processing. It has a resolution capability of 10-m pixels and is capable of producing 1:50,000-scale image maps with 20-m contours. In addition to mapping, the system is designed to monitor the works of man as well as nature and in a cost-effective manner.

Author

A86-21115#

MOS-1 AND ERS-1

T. IGARASHI (National Space Development Agency of Japan, Tokyo) IN: International Symposium on Remote Sensing of Environment, 18th, Paris, France, October 1-5, 1984, Proceedings. Volume 1. Ann Arbor, MI, Environmental Research Institute of Michigan, 1985, p. 167-186.

On 9 August 1984, the Space Activities Commission of Japan decided the policy to estimate the budget for the development of Earth Resources Satellite No. 1, according to this policy, Science and Technology Agency and Ministry of International Trade and Industry are seeking the approval for the new start of the design and development phases of ERS-1. Meanwhile, Marine Observation Satellite No. 1 is underway in manufacturing and test phases. This paper describes Japan's MOS-1 and ERS-1 program, their status, planning and objectives and provides a description of space segments and ground segments.

Author

A86-21117#

CANADA'S SYNTHETIC APERTURE RADAR SATELLITE

E. J. LANGHAM, E. SHAW, and R. K. RANEY (Canada Centre for Remote Sensing, Ottawa) IN: International Symposium on Remote Sensing of Environment, 18th, Paris, France, October 1-5, 1984, Proceedings. Volume 1. Ann Arbor, MI, Environmental Research Institute of Michigan, 1985, p. 191-199.

The developmental history of Canadian synthetic aperture radar satellite for Arctic resource monitoring, RADARSAT, is given. The criteria used to establish hardware electronics requirements for the RADARSAT spacecraft, the radar, and the ground segment of the system are discussed. The main applications of RADARSAT data are described, including: daily monitoring of changes in the structural characteristics of ice masses; wave monitoring; and orbit exploration. A schematic diagram of the RADARSAT on-orbit configuration is provided.

I.H.

A86-21136#

THE REMOTE SENSING SATELLITE PROGRAM OF JAPAN

T. IGARASHI (National Space Development Agency of Japan, Tokyo) IN: International Symposium on Remote Sensing of Environment, 18th, Paris, France, October 1-5, 1984, Proceedings. Volume 1. Ann Arbor, MI, Environmental Research Institute of Michigan, 1985, p. 399-408.

The remote-sensing satellite program of Japan is described, with special reference to the aspects of its commercial operations. Three projects are discussed: (1) the MOS-1 project (its satellite to be launched in summer 1986), which is to establish the mission performance of the earth observation system (MOS-1 satellite and ground segment) and the usefulness of MOS-1 data for the user community; (2) the ERS-1 project (to be launched in 1990), the main purposes of which are to establish the earth observation techniques of microwave sensors and to explore the earth's nonrenewable resources, as well as to monitor land use, environment preservation, prevention of disasters, and coastal zone changes; and (3) the Earth Observation Satellite Application project, which includes the establishment of the ground station for earth observation satellites and operation and processing of Landsat, MOS-1, and other satellite data. Results of marketing research on the Landsat data sales and distributions are included.

I.S.

A86-21138#

FUTURE SATELLITE EARTH OBSERVATION GROUND SYSTEMS

T. IGARASHI, K. ARAKI, T. GOKA, Y. ISHIDO, and M. KOJIMA (National Space Development Agency of Japan, Tokyo) IN: International Symposium on Remote Sensing of Environment, 18th, Paris, France, October 1-5, 1984, Proceedings. Volume 1. Ann Arbor, MI, Environmental Research Institute of Michigan, 1985, p. 419-433.

MSS and TM data from Landsat 5 are now received and processed at the Earth Observation Center (EOC) of NASDA which is located in the middle part of the Saitama Prefecture approximately 50 km away from Tokyo. MOS-1 (Marine Observation Satellite-1), the first Japanese earth observation satellite, is now under development with a launch target in 1986. Four mission payloads, Multispectral Electric Self Scanning Radiometer (MESSR), Visible and Thermal Infrared Radiometer (VTIR), Microwave Scanning Radiometer (MSR), and Data Collection System (DCS), are installed on MOS-1. Data acquisition, processing, and mission control systems will be installed in EOC. The system requirements and configuration of MOS-1 ground systems are reported.

Author

A86-21139#

EVALUATION OF MOS-1 MICROWAVE SCANNING RADIOMETER (MSR) DATA IN FIELD EXPERIMENTS

K. ARAI, T. IGARASHI, C. ISHIDA, H. WAKABAYASHI, and Y. TAKAGI (National Space Development Agency of Japan, Tokyo) IN: International Symposium on Remote Sensing of Environment, 18th, Paris, France, October 1-5, 1984, Proceedings. Volume 1. Ann Arbor, MI, Environmental Research Institute of Michigan, 1985, p. 435-444.

The Microwave Scanning Radiometer (MSR) is an imaging 2-frequency radiometer that will be flown on the first Japanese remote sensing satellite, MOS-1 in 1986. In order to evaluate the sensor parameters and to establish the basic data processing algorithms, NASDA has carried out field experiments and data analysis with three cooperative institutes from 1981 to 1984. This paper presents the early results from one phase of research carried out for the measurement of snowpack properties, atmospheric water vapor content, cloud liquid content, and sea-surface wind velocity.

Author

A86-21151#**RESULTS AND FUTURE ASPECTS OF CO₂-LASER SYSTEMS IN REMOTE SENSING**

F. LEHMANN (Muenchen, Universitaet, Munich, West Germany), W. WIESEMANN (Battelle-Institut, Frankfurt am Main, West Germany), and C. WERNER (DFVLR, Munich, West Germany) IN: International Symposium on Remote Sensing of Environment, 18th, Paris, France, October 1-5, 1984, Proceedings. Volume 1. Ann Arbor, MI, Environmental Research Institute of Michigan, 1985, p. 555-562. BMTF-supported research. refs

The application possibilities of MID-IR laser spectroscopy to remote sensing were investigated in laboratory work and flight campaigns. For the flight measurements, the DIALEX instrument, a profiling laser spectrometer with two tunable CO₂-lasers was used. The lasers are tunable on about 60 lines (bandwidth about 10 to the -5th microns) from 9 to 11 microns in the thermal infrared region. Due to the very low power of the received laser radiation, the system is working with heterodyne detection. In the laboratory, the reflection spectra of minerals, soils, rocks, vegetation, water, moistured surfaces and oil spills on water were taken. Most of the soil- and rockforming minerals (especially the silicates) show characteristic spectral signatures in the MID-IR, where Reststrahlenbands occur. Using four laser lines, it is possible to detect soil- and rock types. With increasing surface moisture content, the spectral signature of a surface is turning to the spectral signature of pure water. Oil spills and vegetation are showing broad spectral signatures too in the measuring range. The data of the flight measurements (soil-, rock surfaces, water, irrigated field, vegetation, asphalt) are in good agreement with the corresponding laboratory results (in-situ measurements). The mean deviation between these data is about + or - 15 percent. Based on these results, a program was started for the development of a multisensor active and passive system combining a near-infrared-multispectral-scanner with a CO₂-laser-scanner. Author

A86-21156#**HIGH RELIEF TERRAIN CLASSIFICATION USING DIGITAL ELEVATION MODEL VARIABLES AND LANDSAT MSS DATA IN THE YUKON TERRITORY, CANADA**

S. E. FRANKLIN and E. F. LEDREW (Waterloo, University, Canada) IN: International Symposium on Remote Sensing of Environment, 18th, Paris, France, October 1-5, 1984, Proceedings. Volume 1. Ann Arbor, MI, Environmental Research Institute of Michigan, 1985, p. 603-611. Research supported by the Department of Indian Affairs and Northern Development. refs
(Contract NSERC-A-8454)

A86-21163#**DEVELOPMENT OF AN AIRBORNE CCD SCANNER FOR LAND AND SEA APPLICATIONS**

N. J. J. BUNNIK, H. POUWELS, L. AARTMAN, P. BINNENKADE (Nationaal Lucht- en Ruimtevaartlaboratorium, Amsterdam, Netherlands), C. SMORENBURG (Centrale Organisatie voor Toegepast-Natuurwetenschappelijk Onderzoek, Technisch Fysische Dienst TNO, Delft, Netherlands) et al. IN: International Symposium on Remote Sensing of Environment, 18th, Paris, France, October 1-5, 1984, Proceedings. Volume 2. Ann Arbor, MI, Environmental Research Institute of Michigan, 1985, p. 713-721.

An airborne multispectral scanner based on the use of CCD detector arrays has been developed. The device is known as CAESAR (CCD Airborne Experimental Scanner for Applications in Remote Sensing). The CAESAR project has mainly the objective to increase Dutch experience with respect to the application of CCD detectors for earth observation, giving particular attention to the exploration of the technical problem areas associated with the use of CCD detectors. A second objective is related to the stimulation of application-oriented research in the use of multispectral data for land and sea observation by means of a versatile system specified by existing user requirements. After the development and test phase, the project will be continued with an application-oriented evaluation phase to be executed in 1985.

The present article provides a description of the user specifications, the design of the sensor system, and the onboard data handling system. Attention is given to the first results of flight tests conducted in July 1984. G.R.

A86-21164#**LINEAR CHARGE-COUPLED DEVICE DETECTOR FOR MULTISPECTRUM CAMERA**

J. CHABBAL, F. CAPECCHI, and B. POULIQUEN (Thomson-CSF, Division Tubes Electroniques, Boulogne-Billancourt, France) IN: International Symposium on Remote Sensing of Environment, 18th, Paris, France, October 1-5, 1984, Proceedings. Volume 2. Ann Arbor, MI, Environmental Research Institute of Michigan, 1985, p. 723-732.

It is pointed out that the new generation of earth resources survey satellites, such as the French satellite SPOT, employs a pushbroom multispectral imaging system. Such a system provides a number of fundamental improvements over an optomechanical scanned system. These improvements are related to the absence of a scanning mirror, an increased integration time and signal to noise ratio, improved resolution, and offset pointing capability. The present paper is concerned with development work which is to provide linear CCD detectors for use in a pushbroom multispectral instrument, taking into account an employment in the SPOT II instrument. A description is given to the linear CCD detector TH 7801A. Attention is also given to the photoelement structure, design considerations for the output stage, the TH 7801A electrical characteristics, wafer technology, fabrication technology, and approaches to obtain CCDs for high reliability applications. G.R.

A86-21167#**CAPABILITY OF INDIAN SATELLITE BHASKARA TV-DATA TO IDENTIFY LAND FEATURES**

K. S. RAO, S. B. N. RAO, A. NIZAM, B. K. MOHAN, A. SOWMYA (Indian Institute of Technology, Bombay, India) et al. IN: International Symposium on Remote Sensing of Environment, 18th, Paris, France, October 1-5, 1984, Proceedings. Volume 2. Ann Arbor, MI, Environmental Research Institute of Michigan, 1985, p. 759-763.

Bhaskara-II represents one of the experimental satellites which were placed in orbit by India in November 1981. The satellite was launched with the objective to conduct remote sensing operations on the basis of a utilization of a TV camera and microwave radiometers. The employed cameras operate in two spectral bands, including the visible region (0.54-0.66 microns) and the near-infrared region (0.75-0.85 microns). The present paper is concerned with studies that were to determine which land features could be observed with a reasonable amount of clarity. The scene selected for these studies included the Bombay city area, which contains certain easily identifiable features. There are three major lakes in the city, while a river flows in the northern part of the city. Attention is given to the digital preprocessing of Bhaskara image data, and a data analysis. On account of the low resolution, only broad land features could be identified. G.R.

A86-21179#**HRV SPOT CAMERA DETECTION UNIT - OPTICAL AND RADIOMETRIC CHARACTERISTICS**

G. CORLAY, C. HENRY, and J. B. PAUL (Societe d'Etudes et de Realisations Nucleaires, Limeil-Brevannes, France) IN: International Symposium on Remote Sensing of Environment, 18th, Paris, France, October 1-5, 1984, Proceedings. Volume 2. Ann Arbor, MI, Environmental Research Institute of Michigan, 1985, p. 941-955.

The main features of the detection unit for the High Resolution Visible (HRV) push-broom cameras of the SPOT observation satellite are summarized. Operating from a 830-km high orbit, the cameras will view a strip of the earth 60 km wide with a 10-m resolution. The main functions of the detection unit are to convert optical signals into electronic signals, to separate the four spectral bands, and to constitute 6000-pixel detection lines. The main optical and radiometric characteristics are presented: spectral sensitivity, responsivity and spatial uniformity, signal to noise ratio, modulation

transfer function, and geometric characteristics related to image quality. The first flight models have been tested and delivered, and test results give confidence that flight performance will be as required. D.H.

A86-21182#

SURFACE TEMPERATURE AND EMISSIVITY EVALUATION FROM SATELLITE THERMAL INFRARED MEASUREMENTS

C. ULIVIERI (Roma, Università, Rome, Italy), G. CANNIZZARO, and M. RICOTTILLI (Telespazio S.p.A., Rome, Italy) IN: International Symposium on Remote Sensing of Environment, 18th, Paris, France, October 1-5, 1984, Proceedings. Volume 2. Ann Arbor, MI, Environmental Research Institute of Michigan, 1985, p. 989-999. refs

The paper presents some considerations on surface temperature and emissivity assessment by single and multichannel thermal infrared approaches. AVHRR/NOAA-7 measurements have been simulated at 3.7 and 10.5 micron wavelengths; in particular LOWTRAN 5 Code has been used to compute atmospheric transmittance in several typical cloud-free atmospheric conditions. A parametric study has been carried out to estimate the most suitable approaches in terms of accuracy on retrieved surface temperatures and emissivities. They are related to NOAA measurements by corrective functions depending upon all the environmental parameters. Author

A86-21201#

SELF-CALIBRATION METHOD OF THE MICROWAVE RADIOMETER USING TWO TEMPERATURE REFERENCES

N. ZENG, H. ZHANG, and D. REN (Shanghai Research Institute of Microwave Technology, People's Republic of China) IN: International Symposium on Remote Sensing of Environment, 18th, Paris, France, October 1-5, 1984, Proceedings. Volume 2. Ann Arbor, MI, Environmental Research Institute of Michigan, 1985, p. 1227-1235.

To minimize the effect of gain fluctuations on the performance of Hach's radiometer and increase its long-term stability and reliability, a self-calibration method is proposed that uses the same internal temperature references. The calibration method could be performed almost without interrupting temperature measurements at any time during remote sensing operations. It is shown that the method is a convenient way to improve the stability of Hach's radiometer without adding expensive components. D.H.

A86-21208#

FLEXIBLE MULTISPECTRAL LINEAR ARRAY (MLA) SENSORS FOR LANDSAT APPLICATIONS

A. M. MIKA (Hughes Aircraft Research Center, Santa Barbara, CA) IN: International Symposium on Remote Sensing of Environment, 18th, Paris, France, October 1-5, 1984, Proceedings. Volume 3. Ann Arbor, MI, Environmental Research Institute of Michigan, 1985, p. 1321-1330.

The application of large-scale-integrated (LSI) circuit technology to detector arrays has provided a basis for the implementation of the MLA instrument concept. It is now feasible to produce a sensor utilizing high-density linear detector arrays which obviate the need for a scanning mechanism. The MLA concept is discussed, taking into account MLA operation, MLA imaging modes, cross-track pointing geometry, and imaging probability vs time for events of opportunity. The MLA sensor will provide significant improvements in spatial, spectral, and radiometric resolution, coupled with extraordinary flexibility in on-orbit spectral-band selection. Attention is given to the three-element telescope design, an MLA instrument design summary, the structural design, and future variants. G.R.

A86-21227*# Environmental Research Inst. of Michigan, Ann Arbor.

ABSOLUTE CALIBRATION FOR SAR SYSTEMS

P. L. JACKSON, R. W. LARSON, and R. M. MAJEWSKI (Michigan, Environmental Research Institute, Radar Div., Ann Arbor) IN: International Symposium on Remote Sensing of Environment, 18th, Paris, France, October 1-5, 1984, Proceedings. Volume 3. Ann Arbor, MI, Environmental Research Institute of Michigan, 1985, p. 1527-1532. NASA-supported research. refs

Absolute calibration of synthetic aperture radar data is desirable for space and time continuity in earth resource investigations. For this purpose, a calibration signal is used to compare data from a calibration flight, during which precision reflectors are imaged, to data from subsequent SAR flights. The calibration signal duplicates the SAR response from a point source. This signal is amplified and converted by the radar system and processed in precisely the same way as data. Author

A86-21246#

A SYNTHETIC APERTURE RADAR (SAR) FOR COMMERCIAL APPLICATIONS

B. L. BULLOCK (Intera Technologies, Ltd., Calgary, Canada) and A. KOZMA (Michigan, Environmental Research Institute, Ann Arbor) IN: International Symposium on Remote Sensing of Environment, 18th, Paris, France, October 1-5, 1984, Proceedings. Volume 3. Ann Arbor, MI, Environmental Research Institute of Michigan, 1985, p. 1733-1742. refs

Studies leading to the design specifications and subsequent development of a SAR built solely for commercial applications are described. Background searches were made of potential users and their requirements and the corresponding technology. The system developed is called STAR 1 (for Sea-Ice and Terrain Assessment Radar); it is an X-band system installed in a light turboprop aircraft. The data are digitally processed in real time aboard the aircraft and the image is telemetered to a ground station for immediate use. The system is currently operational and has performed a number of tasks including support of arctic drilling and engineering, iceberg detection, arctic transportation, and terrain surveys. D.H.

A86-21249*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

THE EFFECTS OF SENSOR ADVANCEMENTS ON THEMATIC MAPPER DATA CLASSIFICATION

J. R. IRONS, B. L. MARKHAM, R. F. NELSON, D. L. TOLL, D. L. WILLIAMS (NASA, Goddard Space Flight Center, Greenbelt, MD) et al. IN: International Symposium on Remote Sensing of Environment, 18th, Paris, France, October 1-5, 1984, Proceedings. Volume 3. Ann Arbor, MI, Environmental Research Institute of Michigan, 1985, p. 1759-1773. refs

Analyses of Landsat Thematic Mapper (TM) data were conducted to assess the effects of sensor advancements on the thematic classification of remote sensing data. The effects of altering three sensor characteristics (spatial resolution, data quantization, and spectral band configuration) from Landsat Multispectral Scanner (MSS) specifications were investigated using analysis-of-variance (ANOVA). Analyses were conducted on data from two TM scenes: Washington, D.C. (late autumn) and western Pennsylvania (late summer). Results indicate that the contribution of sensor advancements to thematic classification are highly dependent of spectral and spatial scene attributes. D.H.

A86-21256#

EMPIRICAL STUDIES OF THE RELATIONSHIP BETWEEN LANDSAT MSS-DATA AND TOPOGRAPHY

K. HALL and L. OLSSON (Lunds Universitet, Lund, Sweden) IN: International Symposium on Remote Sensing of Environment, 18th, Paris, France, October 1-5, 1984, Proceedings. Volume 3. Ann Arbor, MI, Environmental Research Institute of Michigan, 1985, p. 1835-1844. refs

The study consists of an investigation of the influence of topography on Landsat MSS - data. A digital terrain model was created and data on slope gradient and aspect were derived and

superimposed on the Landsat image. Areas of known homogeneous land cover were studied concerning pixel values and slope gradient and aspect. Although being rather ambiguous results indicate a certain influence of topography on pixel values. This is most obvious for MSS 6 and MSS 7. Band ratioing had no reducing effect. Slope gradients lower than 10 degrees were not found to be affected by the topography. Author

A86-21899* Jet Propulsion Lab., California Inst. of Tech., Pasadena.

PREDICTING EARTH'S DYNAMIC CHANGES

S. I. RASOOL (California Institute of Technology, Jet Propulsion Laboratory, Pasadena; CNRS, Laboratoire de Meteorologie Dynamique, Paris, France) Aerospace America (ISSN 0740-722X), vol. 24, Jan. 1986, p. 78-80, 82.

Given a suitable strategy for conducting measurements, satellite-based remote sensing of the earth can furnish valuable information on the dynamic changes of such planetary characteristics as ocean surface temperatures and atmospheric CO₂. Observations must be global and synoptic, quantitatively validated, and consistent over the long term. A program spanning 20 years will study such critical variables as solar flux, stratospheric temperature, aerosols and ozone, cloud cover, tropospheric gases and aerosols, radiation balance, surface temperature, albedo, precipitation, vegetation cover, moisture, snow and ice, as well as oceanic color, topography, and wind stress. O.C.

A86-22271 IMPROVING YOUR IMAGE

G. BRACHET (SPOT Image Corp., Washington, DC) Space (ISSN 0267-954X), vol. 1, Dec. 1985-Feb. 1986, p. 30-33.

The design characteristics of the Spot spacecraft are described. The Spot spacecraft carries two sensors called HRVs (Haute Resolution Visible) which consist of solid state detector arrays operating in the optical and near infrared regions of the spectrum. Each HRV has a swathwidth of 60 km and can be operated independently. Observations are made in three spectral bands with a pixel size of 20 meters. The three bands include: a green band from 0.50 microns to 0.59 microns; a red band from 0.61 microns to 0.68 microns; and a near infrared band from 0.69 microns to 0.89 microns. A steerable mirror on the Spot spacecraft provides off-nadir viewing capability, allowing scene centers to be targeted anywhere within a 950-km-wide strip centered on the satellite track. The ground receiving stations in the spot data distribution network are located in France and northern Sweden. The contractual arrangements between users and the private organization running the Spot program, SPOT IMAGE, are described in detail. I.H.

A86-22828 SPOT SYSTEM CONCEPTION AND PROGRAM STATUS

M. COURTOIS (CNES, Toulouse, France) IN: SPOT simulation applications handbook; Proceedings of the SPOT Symposium, Scottsdale, AZ, May 20-23, 1984. Falls Church, VA, American Society of Photogrammetry, 1984, p. 8-18.

In February 1978, France, Belgium, and Sweden decided to undertake the development of an experimental earth observation system, called SPOT. The term 'SPOT' represents an acronym for the French name of the system. The space segment of the SPOT system consists of two parts, including the platform and the mission specific payload. The ground segment of SPOT contains the ground control segment and the image reception ground segment. The first SPOT spacecraft is currently under development, and it has been decided to produce and launch a second satellite (SPOT 2). Attention is given to the SPOT platform, the SPOT 1 payload, the HRV instruments, the optics and detection system, electronics, the off-nadir viewing mechanism, calibration, the payload telemetry subsystem, payload programming, image reception and processing, image data compatibility, and geometric image quality. G.R.

A86-22831

TESTING SPOT SATELLITE ACQUISITION STRATEGIES OVER THE UNITED STATES

E. S. MEREDITH and G. M. WEILL (SPOT Image Corp., Washington, DC) IN: SPOT simulation applications handbook; Proceedings of the SPOT Symposium, Scottsdale, AZ, May 20-23, 1984. Falls Church, VA, American Society of Photogrammetry, 1984, p. 37-44.

The SPOT satellite is a flexible and complex data acquisition system. In view of its various programmable modes and high resolution, SPOT represents an intermediate between a Landsat type satellite and a high-altitude aircraft. It is pointed out that some of the experience gained from the 1983 U.S. SPOT Simulation Campaign can be applied to estimate and optimize the potential throughput of the satellite. The satellite performance was estimated on the basis of three programming strategies. Attention is given to aspects of SPOT orbital parameters and data acquisition, questions of satellite programming simulation, the obtained results, and the relation of the simulation to the actual programming of SPOT. G.R.

A86-22840* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

A COMPARATIVE EVALUATION OF SIMULATED SPOT, THEMATIC MAPPER, AND SIMULATED THEMATIC MAPPER DATA IN A WESTERN ECOZONE

J. S. BUIS (NASA, Ames Research Center; Technicolor Government Services, Inc., Moffett Field, CA) IN: SPOT simulation applications handbook; Proceedings of the SPOT Symposium, Scottsdale, AZ, May 20-23, 1984. Falls Church, VA, American Society of Photogrammetry, 1984, p. 130-136. refs

Spectral information content was quantitatively measured for simulated SPOT, Thematic Mapper, and simulated Thematic Mapper data acquired over Santa Cruz County, California. Two techniques were employed: spectral separability summarized through optimal wave band evaluation, and histogram cluster analysis. Using data from the three sources it is shown that three spectral bands can provide separability nearly as high as six bands provide, if the three bands are optimally chosen for the cover type. Analysis of the Santa Cruz scene emphasizes the importance of TM bands 1 and 5 in particular. The three bands of the SPOT scanner are shown to provide sufficient separability for cover types within the study area. The higher spatial resolution data (20 meters) provided by SPOT contain more distinct distributions than data from the other sources studied. Techniques should be developed to exploit this additional information. Author

A86-22842 STATISTICAL ANALYSIS OF SPOT SIMULATION DATA AND COMPARISON WITH LANDSAT 4 THEMATIC MAPPER DATA

J. C. PRICE (USDA, Hydrology Laboratory, Beltsville, MD) IN: SPOT simulation applications handbook; Proceedings of the SPOT Symposium, Scottsdale, AZ, May 20-23, 1984. Falls Church, VA, American Society of Photogrammetry, 1984, p. 157-164. refs

Information content and other statistical quantities were obtained for SPOT simulation data from a site in Prince Georges County, Maryland. The results were compared with those from Landsat Thematic Mapper (TM) data. Correlations are very high (greater than 0.97) between bands 1 and 2 for the SPOT simulation data implying significant redundancy between these channels. These values will decrease as the area considered increases from order 10 sq km to the satellite scene size of 60 (sq km). The efficiency of information collection by simulated SPOT is higher than for the TM scene for the same area. This is due to the higher sun angle corresponding to time of year and to the contrast enhancement of the SPOT simulation data. The ability to discriminate subtle land cover differences is poor for single band 10 m data. It is suggested that 6 or 7 bits will be adequate to represent land use/land cover. For large scale agricultural assessment the value of higher spatial resolution from the SPOT sensor as compared to the TM is offset by the longer revisit time. A swath sampling strategy is suggested which would utilize the

pointing ability of the SPOT sensors to acquire frequent data for some ground tracks. Author

A86-23221

THE METEOROLOGICAL SATELLITE - OVERVIEW OF 25 YEARS OF OPERATION

W. L. SMITH (Wisconsin, University, Madison), W. P. BISHOP, V. F. DVORAK, C. M. HAYDEN, J. H. MCELROY (NOAA, Washington, DC) et al. Science (ISSN 0036-8075), vol. 231, Jan. 31, 1986, p. 455-462. refs

The origin of the meteorological satellite program is traced to a paper published by Goddard (1919) and a payload launched by him in 1929. Advances in rocket technology made during World War II could be utilized to obtain the first pictures of clouds from high altitude in the late 1940's. The first weather satellite, TIROS-I, was launched on April 1, 1960. A description of further developments regarding meteorological satellites, their operation, and accomplishment is presented. Attention is given to cloud imagery, atmospheric motion estimation, severe storm forecasting, tropical storm surveillance, input to numerical forecast models, quantitative measurements of temperature and moisture, forecast applications, and future expectations. G.R.

A86-23222

TERRESTRIAL OBSERVATIONS FROM NOAA OPERATIONAL SATELLITES

H. YATES, A. STRONG, D. MCGINNIS, JR., and D. TARPLEY (NOAA, National Environmental Satellite, Data, and Information Service, Washington, DC) Science (ISSN 0036-8075), vol. 231, Jan. 31, 1986, p. 463-470. refs

The original justification for the operational satellites of the National Oceanic and Atmospheric Administration (NOAA) was related to the objective to satisfy the demands of weather forecasting. Although the meteorological functions remain predominant today, there are now, in addition, also important applications in oceanography, hydrology, and agriculture. In the observation of surface features from satellites, the intervening atmosphere represents a source of disturbances. It has been possible to make the correction needed to achieve the requisite accuracy only in the past two years by using multiple infrared channels on the NOAA advanced very high resolution radiometer (AVHRR). G.R.

A86-23283* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

AN EVALUATION AND COMPARISON OF VERTICAL PROFILE DATA FROM THE VISSR ATMOSPHERIC SOUNDER (VAS)

G. J. JEDLOVEC (NASA, Marshall Space Flight Center; Universities Space Research Association, Huntsville, AL) Journal of Atmospheric and Oceanic Technology (ISSN 0739-0572), vol. 2, Dec. 1985, p. 559-581. Research supported by the Universities Space Research Association. Previously announced in STAR as N85-16351. refs (Contract NAS8-34767)

A statistical evaluation is used to compare vertical profiles of temperature and moisture derived from VISSR Atmospheric Sounder (VAS) with three different algorithms to that of corresponding rawinsonde measurements for a clear cold environment. To account for time and space discrepancies between the data sets, rawinsonde data were adjusted to be representative of the satellite sounding times. Both rawinsonde and satellite sounding data were objectively analyzed onto a mesoscale grid. These grid point values were compared at 50 mb pressure increments from the surface up to 100 mb. The data were analyzed for horizontal and vertical structure, representatives of derived parameters, and significant departure (improvement) from the apriori (first guess) information. Results indicate some rather strong temperature and moisture biases exist in the satellite soundings. Temperature biases of 1 to 4 C and dewpoint biases of 2 to 6 C generally occur in layers where strong inversions are present and vary with time as these atmospheric features evolve. The biases also changes as a function retrieval scheme suggesting limitations and restrictions on the applications of the various techniques.

Standard temperature deviations range from 1 to 2 C for each retrieval scheme with maximum values around 800 and 400 mb. Derived parameters (precipitable water and thickness) suffer from similar biases, though to a somewhat lesser extent. Gradients of basic and derived parameters are generally weaker but have good horizontal structure where magnitudes of the parameters are relatively strong. Integrated thermal (temperature) and moisture (precipitable water) parameters show mixed results. B.W.

A86-24103

FRANCE'S SPOT IMAGE TESTS VIABILITY OF REMOTE SENSING IN A COMMERCIAL MARKET

J. M. LENOROVITZ Commercial Space (ISSN 8756-4831), vol. 1, Summer 1985, p. 26, 27, 29 (3 ff.).

The potential market demand for remote sensing imagery from the SPOT satellite is assessed. A brief description of the SPOT spacecraft and imaging equipment is presented, with emphasis given to the Haute Resolution Visible (HRV) cameras. The wholesale and retail segments of a typical SPOT image transaction are described in detail. The copyright laws pertaining to the sale of duplicated SPOT imagery are considered. I.H.

A86-26350

RETRIEVAL OF WORLDWIDE PRECIPITATION AND ALLIED PARAMETERS FROM SATELLITE MICROWAVE OBSERVATIONS

M. S. V. RAO IN: Advances in geophysics. Volume 26. Orlando, FL, Academic Press, Inc., 1984, p. 237-336. refs

The use of satellite-borne microwave radiometer systems to derive geophysical parameters on a global scale is discussed. The capabilities and limitations of the electrically scanning microwave radiometer (ESMR), Nimbus-5 ESMR, and Nimbus-6 ESMR in calculating rainfall and sea ice parameters are examined. The development of calibration curves to interpret ESMR rainfall data and the verification of the curves are investigated. A comparison of ESMR rainfall maps, generated from calibration curves, with large-scale precipitation maps and localized radar data is presented. The information obtained from the analyses of ESMR rainfall maps concerning new features of global climatology such as a rain area in the South Atlantic, the bimodal behavior of rainbelts in the Indian Ocean, and precipitation in the tropical Atlantic Ocean are described. Storm structure studies and rainfall estimations over land areas conducted with ESMR are analyzed. The application of microwave radiometer systems to the study of atmospheric water content, liquid water content, sea surface temperature, and surface wind is proposed. I.F.

A86-26446* Michigan Univ., Ann Arbor.

MICROWAVE REMOTE SENSING: ACTIVE AND PASSIVE. VOLUME 3 - FROM THEORY TO APPLICATIONS

F. T. ULABY (Michigan, University, Ann Arbor), R. K. MOORE (Kansas, University, Lawrence), and A. K. FUNG (Texas, University, Arlington) Research supported by NASA, NSF, and DOD. Dedham, MA, Artech House, Inc. (Remote Sensing, No. 4), 1986, 1116 p. refs

Aspects of volume scattering and emission theory are discussed, taking into account a weakly scattering medium, the Born approximation, first-order renormalization, the radiative transfer method, and the matrix-doubling method. Other topics explored are related to scatterometers and probing systems, the passive microwave sensing of the atmosphere, the passive microwave sensing of the ocean, the passive microwave sensing of land, the active microwave sensing of land, and radar remote sensing applications. Attention is given to inversion techniques, atmospheric attenuation and emission, a temperature profile retrieval from ground-based observations, mapping rainfall rates, the apparent temperature of the sea, the emission behavior of bare soil surfaces, the emission behavior of vegetation canopies, the emission behavior of snow, wind-vector radar scatterometry, radar measurements of sea ice, and the back-scattering behavior of cultural vegetation canopies. G.R.

A86-26504#

AVNER ELECTRONIC MAGNETIC COMPASS AND LOW COST NAVIGATION SYSTEM

A. SOBEL (Elbit Computers, Ltd., Ground Systems Div., Haifa, Israel) IN: Institute of Navigation, Annual Meeting, 41st, Annapolis, MD, June 25-27, 1985, Proceedings. Washington, DC, Institute of Navigation, 1985, p. 22-28.

A new type of Electronic Magnetic Compass has been developed by Elbit Computers Ltd. This compass corrects the deviations in the Magnetic Compass reading, when mounted on iron body vehicles, by using a classic formula implemented by a microprocessor. This compass is so flexible that it can even correct the deviations caused by the iron body of tanks with rotatable turret. The compass is self calibrated by a computer program which relieves the crew from the complexity of the process. It is argued that this compass has the potential of becoming a low-cost solution to the navigational problems of the large mass of military and commercial land vehicles, aircraft, and ships operating on its own and in conjunction with GPS. The concept and the construction of the compass is explained, some experimental results, and the project status are given. Author

A86-26694

THE IMPORTANCE OF MEASUREMENT ERROR FOR CERTAIN PROCEDURES IN REMOTE SENSING AT OPTICAL WAVELENGTHS

P. J. CURRAN and A. M. HAY (Sheffield, University, England) Photogrammetric Engineering and Remote Sensing (ISSN 0099-1112), vol. 52, Feb. 1986, p. 229-241. refs

Two problems are identified in the use of linear regression to relate remotely sensed data to ground variables: a specification problem and an errors problem. The extent of the errors is examined for commonly measured remotely sensed variables and ground variables. Three alternative methods of line fitting are examined: Wald's grouping methods, the reduced major axis, and a least-squares procedure. The least-squares method is recommended if the data are available. Author

A86-28273

AMERICAN CONGRESS ON SURVEYING AND MAPPING AND AMERICAN SOCIETY OF PHOTOGRAMMETRY, FALL CONVENTION, SAN ANTONIO, TX, SEPTEMBER 9-14, 1984, TECHNICAL PAPERS

Falls Church, VA, American Society of Photogrammetry and American Congress on Surveying and Mapping, 1984, 847 p. No individual items are abstracted in this volume.

The use of Landsat data to update the Texas Dam Inventory is considered along with digital image processing using a personal computer, the use of close-range photography in metric recording of archaeological objects, the processes involved in bringing new analytical stereo compilation equipment into production, an innovative approach for developing and using land information, and a tool for mapping electric utilities. Attention is given to applications of parallel processing techniques to geological data processing, age discrimination among basalt flows using digitally enhanced Landsat imagery, the City of Austin computer graphics mapping system, electrical profiling, and exploration remote sensing. Other subjects explored are related to the multilevel exploration of oil and gas with Landsat imagery, a stereomaging technique for use in the study of the deformation of materials, modern procedures for route surveys, horizontal and vertical positioning by photogrammetric methods, and a satellite Doppler survey within a geodetic reference system. G.R.

A86-29254

METHODS OF SPECTROMETRIC INFORMATION REPRESENTATION AND PROCESSING IN NATURAL SURFACE CLASSIFICATION PROBLEMS [METODY PREDSTAVLENIIA I OBRABOTKI SPEKTROMETRICHESKOI INFORMATSII V ZADACHAKH KLASSIFIKATSII PRIRODNYKH POVERKHNOSTEI]

L. I. KISELEVSKI, A. M. VESHTORT, S. I. KONONOVICH, S. B. KOSTIUKOVICH, and V. V. KRASNOPROSHIN (Belorusskii Gosudarstvennyi Universitet; AN BSSR, Institut Fiziki, Minsk, Belorussian SSR) Akademiia Nauk BSSR, Doklady (ISSN 0002-354X), vol. 30, no. 2, 1986, p. 128-131. In Russian. refs

A86-29403

GENERATING FALSE-COLOR COMPOSITES WITH A WHITE-LIGHT OPTICAL PROCESSOR

F. T. S. YU and G. W. PETERSEN (Pennsylvania State University, University Park) Photogrammetric Engineering and Remote Sensing (ISSN 0099-1112), vol. 52, March 1986, p. 367-371. USAF-DOE-supported research. refs

A technique of false-color compositing by encoding multispectral remote sensing data with a low-cost white-light optical processor is described. Spatial encodings are made with various multispectral band image transparencies, and false-coloring is obtained by color filtering the smeared Fourier spectra. In contrast to the low-resolution digital image, the white-light method generates a high-quality color-coded product. This image is free from coherent artifact noise because coherent light sources are not used. This simple and versatile technique may offer a wide range of applications. Three bands of multispectral Landsat data were processed using 70-mm black-and-white film negatives. These false-color encoded images allowed for discrimination of various earth surface features. Forests, agricultural lands, water, urban areas, and strip mines could be shown on the images as each of these thematic classes were displayed as a different color. Author

N86-16690*# Environmental Research Inst. of Michigan, Ann Arbor. Infrared and Optics Div.

STUDY OF SPECTRAL/RADIOMETRIC CHARACTERISTICS OF THE THEMATIC MAPPER FOR LAND USE APPLICATIONS Final Report, 21 Sep. 1982 - 20 Jun. 1985

W. A. MALILA, Principal Investigator and M. D. METZLER, Principal Investigator Sep. 1985 54 p refs Original contains imagery. Original photography may be purchased from the EROS Data Center, Sioux Falls, S.D. 57198 ERTS (Contract NAS5-27346)

(E86-10025; NASA-CR-176269; NAS 1.26:176269;

ERIM-164000-19-F) Avail: NTIS HC A04/MF A01 CSCL 08B

An investigation conducted in support of the LANDSAT 4/5 Image Data Quality Analysis (LIDQA) Program is discussed. Results of engineering analyses of radiometric, spatial, spectral, and geometric properties of the Thematic Mapper systems are summarized; major emphasis is placed on the radiometric analysis. Details of the analyses are presented in appendices, which contain three of the eight technical papers produced during this investigation; these three, together, describe the major activities and results of the investigation.

N86-16691*# Environmental Research Inst. of Michigan, Ann Arbor. Infrared and Optics Div.

STUDY OF SPECTRAL/RADIOMETRIC CHARACTERISTICS OF THE THEMATIC MAPPER FOR LAND USE APPLICATIONS: OBJECTIVES, ACCOMPLISHMENTS, CONCLUSIONS, AND RECOMMENDATIONS Final Report

W. A. MALILA and M. D. METZLER In its Study on Spectral/Radiometric Characteristics of the Thematic Mapper for Land Use Applications p 1-4 Sep. 1985 refs ERTS Avail: NTIS HC A04/MF A01 CSCL 05B

The objectives of this investigation are to quantify the performance of the Thematic Mapper, as manifested by the quality of its image data, in order to suggest improvements in data production and to assess the effects of the data quality on its

utility for land resources applications. Analyses of radiometric, spatial, spectral, and geometric effects, with primary emphasis on radiometric effects are included. This effort is part of the LANDSAT 4/5 Image Data Quality Analysis (LIDQA) program sponsored by the NASA Goddard Space Flight Center. Author

N86-16692*# Environmental Research Inst. of Michigan, Ann Arbor. Infrared and Optics Div.

CHARACTERIZATION OF LANDSAT-4 MSS AND TM DIGITAL IMAGE DATA

W. A. MALILA, M. D. METZLER, D. P. RICE, and E. P. CRIST *In its Study on Spectral/Radiometric Characteristics of the Thematic Mapper for Land Use Applications* p 5-20 Sep. 1985 refs Repr. from IEEE Transactions on Geoscience and Remote Sensing, v. GE-22, no. 3, May 1984 p 177-191 Previously announced in IAA as A84-33526 Original contains imagery. Original photography may be purchased from the EROS Data Center, Sioux Falls, S.D. 57198 ERTS

(Contract NAS5-27254)

Avail: NTIS HC A04/MF A01 CSCL 05B

The launch of LANDSAT-4 in July 1982 represents a continuation in the remote sensing of earth resources. The 80-m spatial resolution provided by the Multispectral Scanner (MSS) on board the satellite is fine enough to resolve many natural features and land-use details in both rural and urban settings. The second sensor of the spacecraft, the Thematic Mapper (TM), introduce a new era of sensing with refined spatial resolution (30 m) and expanded spectral coverage (7 bands). This paper describes results from engineering studies of the characteristics of digital image data from the two LANDSAT-4 sensors are described. These studies form a part of the LANDSAT-4 Image Data Quality Analysis program (LIDQA). The image data were generally found to be of high quality and the TM provided several improvements over the MSS, in its spatial and spectral characteristics. Author

N86-16693*# Environmental Research Inst. of Michigan, Ann Arbor. Infrared and Optics Div.

CHARACTERIZATION AND COMPARISON OF LANDSAT-4 AND LANDSAT-5 THEMATIC MAPPER DATA

W. A. MALILA and M. D. METZLER *In its Study on Spectral/Radiometric Characteristics of the Thematic Mapper for Land Use Applications* p 21-37 Sep. 1985 refs Repr. from Photogrammetric Engineering and Remote Sensing, v. 51, no. 9, Sep. 1985 p 1315-1330 Previously announced in IAA as A85-47809 ERTS

Avail: NTIS HC A04/MF A01 CSCL 08B

Engineering analyses of Thematic Mapper (TM) image data have been conducted, giving particular attention to the radiometric characterization of the sensor. While the data in general were found to be excellent, anomalies do exist in the data from both LANDSAT-4 and LANDSAT-5 TM. A summary is provided of the LANDSAT-5 TM image data. Recent analyses of LANDSAT-5 TM data and comparisons of the radiometry of the two sensors are emphasized. One of the specific topics covered is within-line droop, a phenomenon whereby the signal levels of the sensor change systematically during the active scan. Attention is also given to scan-correlated level shifts, an effect which raises or lowers the signal level of all pixels in a scan line or set of scan lines. A comparison of LANDSAT-4 and LANDSAT-5 radiometric corrections is also discussed. Author

N86-17814*# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).

CNPQ/INPE-LANDSAT SYSTEM Report of Activities, 1 Oct. 1984 - 31 Aug. 1985

J. L. DEBARROSAGUIRRE Sep. 1985 28 p Presented at the LANDSAT Ground Station Operators Working Group and LGSOWG Data Distribution and Marketing Working Group meetings, Washington, D.C., Sep. 1985 Sponsored by NASA ERTS (E86-10019; NASA-CR-175884; NAS 1.26:175884; INPE-3635-PRE/812) Avail: NTIS HC A03/MF A01 CSCL 05B

The current status of the Brazilian LANDSAT facilities operated by Instituto de Pesquisas Espaciais (INPE) and the results achieved during the period from October 1, 1984 to August 31, 1985 are presented. INPE's Receiving Station at Cuiaba, MT, operates normally the two tracking and receiving systems it has installed, the old one (1973) for Band S and the new one (February 1983) for dual S- and X-band. Both MSS and TM recording capabilities are functional. Support to the NASA Backup Plan for MSS data also remains active. Routine recordings are being made for LANDSAT-5 only, for both MSS and TM. Originally, MSS was recorded over the full acquisition range. However, since December, 1984, due to further reduction of operational expenses, both instruments are being recorded over Brazilian territory only. Author

N86-17816*# Arizona Univ., Tucson. Optical Sciences Center. SPECTRORADIOMETRIC CALIBRATION OF THE THEMATIC MAPPER AND MULTISPECTRAL SCANNER SYSTEM Quarterly Report, 1 Jun. - 31 Aug. 1985

P. N. SLATER and J. M. PALMER, Principal Investigators 30 Sep. 1985 18 p ERTS

(Contract NAS5-27832)

(E86-10022; NASA-CR-175861; NAS 1.26:175861; QR-11) Avail: NTIS HC A02/MF A01 CSCL 08B

The eleventh quarterly report on Spectroradiometric Calibration of the Thematic Mapper (Contract NAS5-27832) discusses calibrations made at White Sands on 24 May 1985. An attempt is made to standardize test results. Critical values used in the final steps of the data reduction and the comparison of the results of the pre-flight and internal calibration (IC) data are summarized. F.M.R.

N86-18351# European Space Agency, Paris (France).

PROCEEDINGS OF THE EARSEL/ESA SYMPOSIUM ON EUROPEAN REMOTE SENSING OPPORTUNITIES: SYSTEMS, SENSORS, AND APPLICATIONS

N. LONGDON, comp. and O. MELITA, comp. Jun. 1985 267 p refs Partly in ENGLISH and FRENCH Proc. held in Strasbourg, 31 Mar. - 3 Apr. 1985; sponsored by Council of Europe, Commission of the European Communities, CNES and Strasbourg University (ESA-SP-233; ISSN-0379-6566) Avail: NTIS HC A12/MF A01

Remote sensing platforms and sensors; collection, processing, and dissemination of remotely sensed data in Europe; Spacelab Metric Camera experiments; the Modular Opto-electronic Multispectral Scanner; and remote sensing applications to thematic mapping, pollution monitoring, archaeology, and geology were discussed.

N86-18353# Marconi Space Systems Ltd., Portsmouth (England).

THE ERS-1 ACTIVE MICROWAVE INSTRUMENTATION (AMI) DESIGN CONSTRAINTS

F. G. SAWYER and D. J. Q. CARTER *In ESA Proceedings of EARSEL/ESA Symposium on European Remote Sensing Opportunities: Systems, Sensors, and Applications* p 13-19 Jun. 1985 refs

Avail: NTIS HC A12/MF A01

The requirements for the ERS-1 Active Microwave Instrument (AMI) to act as a wind scatterometer, a wave scatterometer and an imaging radar are considered. For the second two instruments the AMI is configured to operate as a synthetic aperture radar and performance requirements in these two modes are very similar;

for the first instrument it is configured to operate as a noncoherent pulsed radar. Design constraints resulting from function requirements, on-board radar components, the ERS-1 platform and interfaces, and ground processing equipment are considered.

Author (ESA)

N86-18359# Politecnico di Milano (Italy). Ist. di Topografia, Fotogrammetria e Geofisica.

OUTSTANDING RESULTS FROM ONE YEAR'S ACTIVITIES OF THE ESA METRIC CAMERA WORKING GROUP

G. TOGLIATTI *In* ESA Proceedings of EARSeL/ESA Symposium on European Remote Sensing Opportunities: Systems, Sensors, and Applications p 57-61 Jun. 1985 refs

Avail: NTIS HC A12/MF A01

Results of the Spacelab Metric Camera experiment on STS-9 in photogrammetry: (precision, triangulations, point identification and mapping, orthophotos); thematic interpretations; and geological interpretation are summarized. Performance is fairly satisfactory in topographic mapping and in geological and thematic applications, with shortcomings in features identification, mainly due to poor lighting conditions and absence of image motion compensation. The metric accuracy of the images is very good, and in several cases better than expected.

Author (ESA)

N86-18361# Technische Univ., Hanover (West Germany). Inst. for Photogrammetry and Engineering Surveys.

LINE MAP PRODUCTION WITH METRIC CAMERA DATA

G. KONECNY and W. SCHUHR *In* ESA Proceedings of EARSeL/ESA Symposium on European Remote Sensing Opportunities: Systems, Sensors, and Applications p 69-73 Jun. 1985 refs

Avail: NTIS HC A12/MF A01

The way to derive empiric exposure functions for optimal picture quality and to get the Modulation Transfer Function (MTF) from edge analysis; and photogrammetric evaluations of Spacelab Metric Camera imagery to derive line maps and quasi line maps are dealt with. It is possible to derive sufficient information from high altitude photography to estimate an empiric solar angle and diaphragm depending empiric exposure function for space photography. From edge analyses the MTF shows 40 line pairs per mm for extremely high contrast, which is equivalent to 10 m pixel size on the ground. The imagery is sufficient for topographic mapping on scales of 1:100 000, and meets all requirements of a reference data base for medium scale mapping purposes. Conventional line maps derived from photogrammetric evaluation with analytical plotters and quasi line maps from digital edge-enhanced Metric Camera imagery are promising for map production in developing countries.

Author (ESA)

N86-18362# Institut National de la Recherche Agronomique, Paris (France).

USE OF METRIC CAMERA FOR LANDSCAPE UNITS: DESCRIPTION AND MAPPING

C. M. GIRARD *In* ESA Proceedings of EARSeL/ESA Symposium on European Remote Sensing Opportunities: Systems, Sensors, and Applications p 75-78 Jun. 1985 refs

Avail: NTIS HC A12/MF A01

Data from a Spacelab Metric Camera flight in winter over France were used to describe landscape units. The use of stereoscopy enabled the description of data concerning geomorphology, which was not possible when using LANDSAT images. The color infrared film enabled to distinguish and evaluate vegetation. The high resolution permitted to evaluate the field size and the presence of hedges. The main types of land use were recognized and the comparison of landscape units with government publications is encouraging.

Author (ESA)

N86-18363# Technische Univ., Munich (West Germany). Lehrstuhl fuer Geographie und Geographische Fernerkundung.

ANALYSIS OF THE METRIC CAMERA MC-BW FOR LAND USE CLASSIFICATION AND LAND USE HAZARD MANAGEMENT (THEMATIC MAPPING OF METRIC CAMERA SPACELAB BLACK AND WHITE PHOTOGRAPHS)

H. G. GIERLOFF-EMDEN *In* ESA Proceedings of EARSeL/ESA Symposium on European Remote Sensing Opportunities: Systems, Sensors, and Applications p 79-84 Jun. 1985 refs

Avail: NTIS HC A12/MF A01

Metric Camera (MC) photographs were analyzed concerning land use and classification, and thematic mapping in test areas in Chihuahua, Mexico. Ground check was carried out in the test areas (not at the same time as the flight). Results show that an MC-image could serve as auxiliary means for thematic mapping in scales around 1:100,000 and smaller scales of larger areas.

Author (ESA)

N86-18366# Karlsruhe Univ. (West Germany). Inst. fuer Photogrammetry and Topography.

FUTURE MODULAR OPTOELECTRONIC MULTISPECTRAL SCANNER (MOMS) DEVELOPMENTS: DISCUSSION OF IMPROVEMENTS AND POSSIBILITIES TO BE EXPECTED FOR GEOLOGICAL APPLICATIONS

J. BODECHTEL (Technische Univ., Munich, West Germany) and H. KAUFMANN *In* ESA Proceedings of EARSeL/ESA Symposium on European Remote Sensing Opportunities: Systems, Sensors, and Applications p 93-96 Jun. 1985 refs

Avail: NTIS HC A12/MF A01

On the basis of digital terrain models and corresponding thematic mapper data, the impact of MOMS instrument developments like Stereo-MOMS and SWIR-MOMS are discussed to optimize parameters especially for geology applications. Choice and width of bands, and application oriented processing concepts are considered.

Author (ESA)

N86-18369# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Wesseling (West Germany).

AN OPTICAL MULTISENSOR COMBINING MID IR LASER SCANNER, AND NEAR IR MULTISPECTRAL SCANNER (LIMES)

F. LEHMANN, C. WERNER, and W. WIESEMANN (Battelle Inst.) *In* ESA Proceedings of EARSeL/ESA Symposium on European Remote Sensing Opportunities: Systems, Sensors, and Applications p 115-119 Jun. 1985 refs

Avail: NTIS HC A12/MF A01

The application possibilities of thermal infrared laser spectroscopy for remote sensing were investigated in laboratory and flight campaigns. For the flight measurements, a profiling laser spectrometer with 2 tunable CO₂ lasers was used. In the laboratory, the reflection spectra of minerals, soils, rocks, vegetation, water, moistened surfaces and oil spills on water were taken. Flight measurements (soil, rock surfaces, water, irrigated field, vegetation, asphalt) agree with the laboratory results (in-situ measurements). Based on these results, a program for the development of an optical multisensor, combining mid IR laser scanner and near IR-multispectral scanner was started.

Author (ESA)

N86-18375# University Coll., London (England). Dept. of Electrical Engineering.

GEOPHYSICAL RADAR ALTIMETERS FOR THE 1990'S

H. D. GRIFFITHS and C. G. RAPLEY *In* ESA Proceedings of EARSeL/ESA Symposium on European Remote Sensing Opportunities: Systems, Sensors, and Applications p 157-165 Jun. 1985 refs Sponsored by ESA

Avail: NTIS HC A12/MF A01

Satellite-borne altimeter concepts for altimetric mission are described. These include developments in on-board adaptive processing algorithms and advances in radar hardware technology, which allow significantly-increased coverage of land and land ice surfaces. Beam-limited altimeters overcome the fundamental disadvantages of pulse-limited instruments over these surfaces, and allow considerably lower transmitter powers, though at the

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expense of large antenna structures and severe spacecraft pointing constraints. Concepts for antenna signal processing utilizing multiple antenna beams to give increased spatial coverage as well as improved performance over nonocean surfaces are presented. Author (ESA)

N86-18376# Centre National d'Etudes Spatiales, Toulouse (France).

THE VARAN-S: AN AIRBORNE SYNTHETIC APERTURE RADAR FOR RESEARCH IN MICROWAVE REMOTE SENSING

D. VAILLANT *In* ESA Proceedings of EARSEL/ESA Symposium on European Remote Sensing Opportunities: Systems, Sensors, and Applications p 167-174 Jun. 1985 refs

Avail: NTIS HC A12/MF A01

The VARAN-S X-Band side-looking airborne radar was designed to simulate satellite-borne radar images to prepare microwave remote sensing users for future satellite data analyses, and to help in the development of satellite-borne SAR. It was experimented in real aperture mode during the Marginal Ice Zone experiment. The VARAN-S is planned to work in SAR mode. The digital raw data, recorded on-board over a swath width 10 km, gives 3 m resolution without multilook, or 9 m using 9 looks. Two polarizations (H and V) are available. Author (ESA)

N86-19705# Meteorological Office, Bracknell (England).

WIND DIRECTION AMBIGUITY SUPPRESSION ALGORITHMS

D. OFFILER *In* ESA The Use of Satellite Data in Climate Models p 175-176 Sep. 1985 refs

(Contract ESA-6154/85/NL-BI)

Avail: NTIS HC A10/MF A01

The problem of removing the ambiguity in the ERS-1 Active Microwave Instrument scatterometer wind directions is discussed. The scatterometer product was simulated using the C-band model with winds from the UK Meteorological Office forecast model. Objective and subjective means were used to suppress the ambiguity. The objective method was divided into two separate algorithms: one using no external data, the other using an independent wind field. The algorithms are described and results presented. Author (ESA)

N86-19709 New South Wales Univ., Kensington (Australia).

A COMPARISON OF SPACE VECTORS DERIVED FROM SATELLITE DOPPLER OBSERVATIONS Abstract Only

D. F. WOOD 1984 2 p

Avail: Issuing Activity

A multi-station Doppler observation program was conducted across the Australian continent between February and June of 1982. Each phase of the program included up to thirteen Doppler Satellite receivers which had been manufactured by the Magnavox Company in U.S.A. The object of this project was to ascertain the accuracy of the Magnavox receivers in determining a position by the technique of semi-short arc translocation when compared to known terrestrial data. The Magnavox results have also been compared to the same satellite data which was processed in the computer programs PREDOP-GEODOP. Author

N86-20260# Joint Publications Research Service, Arlington, Va. **USE OF A PRIORI EVALUATION OF CONDITIONS FOR OBSERVING EARTH'S SURFACE FROM SPACE FOR EFFECTIVE CHOICE OF TIME FOR EXECUTING SURVEY Abstract Only**

N. V. KAPITONOVA and Y. L. LUKASHEVICH *In* its USSR Report: Space (JPRS-USP-86-001) p 155 13 Jan. 1986 Transl. into ENGLISH from Issledovaniye Zemli iz Kosmosa (Moscow, USSR), no. 1, Jan. - Feb. 1985 p 113-117 Original language document was announced in IAA as A85-29914

Avail: NTIS HC A03

Adequate study has been made of the motion of space vehicles for studying the Earth's natural resources, such as the nominal parameters of their working orbits, but a weak link which remains is the uncertainty in choice of the initial orientation of the orbital plane relative to the direction to the Sun. This orientation is determined by the angle $\tau = \alpha - \omega$, where α is the

right ascension of the Sun on the initial date of the survey, ω is the longitude of the ascending node of the space vehicle orbit, unambiguously related to the illumination conditions for the Earth's surface along the flight trajectory. A method has been developed for determining a rational ω value which would make possible the most complete satisfaction of requirements on solar altitude in surveys of different regions, taking their meteorological and climatic characteristics into account. For this purpose the Earth's surface, which is to be photographed from a circular orbit from a satellite with a specific inclination, is broken down into regions with characteristic climatic conditions. R.J.F.

N86-20438# Joint Publications Research Service, Arlington, Va. **WORLD'S LARGEST CAMERA FOR SATELLITE OBSERVATION INSTALLED AT ZVENIGOROD**

M. ROGOZHNIKOV *In* its USSR Report: Space (JPRS-USP-86-002) p 18-19 10 Feb. 1986 Transl. into ENGLISH from Leninskoye Znamya (Moscow, USSR), 17 Oct. 1985 p 4

Avail: NTIS HC A05

The world's largest camera for observing artificial Earth satellites was installed at the Zvenigorod station of the USSR Academy of Sciences' Astronomical Council. Small deviations of geostationary satellites from their prescribed orbits sometimes occur. At regular intervals, it is necessary to give them a push -- to correct their orbits. The photographing of satellites from Earth is still the most precise and accurate method for determining their coordinates. The camera was installed near Zvenigorod for this purpose. Author

N86-20912# Joint Publications Research Service, Arlington, Va. **RADIOMETRIC AIRBORNE MOISTURE METER**

M. GUSEV *In* its USSR Report: Earth Sciences (JPRS-UES-86-001) p 34 10 Jan. 1986 Transl. into ENGLISH from Trud (Moscow, USSR), 19 Jul. 1985 p 4

Avail: NTIS HC A04

The moisture meter is an instrument which gives accurate recording of the presence of moisture in the ground from an airplane. With the aid of the meter, the reasons for the flooding of three settlements with ground water were established and the place where the ground water was accumulating was discovered. As the temperature of the ground changes, changes also occur in the boundaries of this spectrum and the ground's radiation-brightness temperature which vary according to the amount of moisture. The instrument measures the ground's radiation brightness temperature. E.A.K.

N86-20936# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).

THE BRAZILIAN REPORT TO THE 7TH LANDSAT TECHNICAL WORKING GROUP (LTWG) MEETING

J. L. D. AQUIRRE, L. E. M. PARADA, and S. D. PEREIRA Oct. 1985 10 p Presented at the 7th LTWG Meeting, Williamsburg, Va., 26 Feb. - 1 Mar. 1985 Sponsored by NASA (NASA-CR-176592; NAS 1.26:176592; INPE-3672-PRE/826)

Avail: NTIS HC A02/MF A01 CSCL 05B

Described is the current status of the INPE LANDSAT receiving and processing facilities, as well as the experience in the related activities during the period from June 1984 to February 1985. Author

N86-20937*# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).

BRAZIL'S REMOTE SENSING ACTIVITIES IN THE EIGHTIES

M. A. RAUPP, R. PEREIRADACUNHA, and R. A. NOVAES Oct. 1985 7 p Presented at the 5th Selper Meeting, Ottawa, Ontario, 15-19 Jul. 1985

(NASA-CR-176591; NAS 1.26:176591; INPE-3671-PRE/825)

Avail: NTIS HC A02/MF A01 CSCL 05B

Most of the remote sensing activities in Brazil have been conducted by the Institute for Space Research (INPE). This report describes briefly INPE's activities in remote sensing in the last years. INPE has been engaged in research (e.g., radiance studies),

development (e.g., CCD-scanners, image processing devices) and applications (e.g., crop survey, land use, mineral resources, etc.) of remote sensing. INPE is also responsible for the operation (data reception and processing) of the LANDSATs and meteorological satellites. Data acquisition activities include the development of CCD-Camera to be deployed on board the space shuttle and the construction of a remote sensing satellite.

Author

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Includes economic analysis.

A86-19487

REMOTE SENSING RESEARCH - THE PAST AS PROLOG

D. A. LANDGREBE (Purdue University, West Lafayette, IN) IN: Remote sensing; Proceedings of the Meeting, Arlington, VA, May 1, 2, 1984. Bellingham, WA, SPIE - The International Society for Optical Engineering, 1984, p. 130-135.

It is pointed out that the remote sensing community has a major opportunity at the present time which it must seize and use effectively. This opportunity is related to the undeveloped potential of the technology, the base of new fundamental knowledge now available, and the recognition that some good planning must now be done. The basic elements of a remote sensing research program are introduced, and the assembly of these elements into a unified program is considered. The elements of the development dimension include basic research, technology research, earth surface research, application research, projects, and operations. Elements of the system dimension include sensor, preprocessing, data analysis, and user application. G.R.

A86-19488

MAPPING THE EARTH FROM SPACE IN THE 1980'S

R. WELCH (Georgia, University, Athens) IN: Remote sensing; Proceedings of the Meeting, Arlington, VA, May 1, 2, 1984. Bellingham, WA, SPIE - The International Society for Optical Engineering, 1984, p. 136-146. refs

The present paper has the objective to review the status of mapping the earth from satellite image data. Since the launch of Landsat-1 by NASA in 1972, satellite remote sensing has expanded rapidly. Major programs concerned with the provision of image data on a global basis are currently being developed by the governments of Canada, France, Germany, India, and Japan, as well as by the U.S. Satellite data which are suited for mapping applications must have adequate spatial and spectral resolution to permit the compilation of cartographic products at scales of 1:25,000 to 1:100,000. Attention is given to aspects of resolution, geometry, planimetry, elevations, and the merging of data sets.

G.R.

A86-19489

FUTURE OF REMOTE SENSING - A VIEWPOINT FROM INDUSTRY

A. B. PARK (Natural Resources Consulting Services, Arnold, MD) IN: Remote sensing; Proceedings of the Meeting, Arlington, VA, May 1, 2, 1984. Bellingham, WA, SPIE - The International Society for Optical Engineering, 1984, p. 148-151.

It appears that the present paper is presented at a critical time in the life of land remote sensing. The technology involved is just over 20 years old, and remote sensing has undergone a remarkable growth during this time. An intensive effort is currently being made to create a Commercial Land Remote Sensing (CRLS) system including both space and ground segments. The present time represents a major milestone in remote sensing. This milestone serves to divide the program into two segments, including a research program largely but not completely sponsored by the Federal Government, and commercial program driven almost

entirely by the profit motive. Over the past five years, industry has intensely studied the viability of a commercial program. It was concluded that money could be made by industry in operating the ground segment. Such a result leaves in the hands of the government the space segment and the space/ground communications responsibility. G.R.

A86-19490

RECENT ADVANCES IN CIVIL SPACE REMOTE SENSING; PROCEEDINGS OF THE MEETING, ARLINGTON, VA, MAY 3, 4, 1984

H. W. YATES, ED. (NOAA, National Environmental Satellite, Data, and Information Service, Washington, DC) Meeting sponsored by SPIE - The International Society for Optical Engineering. Bellingham, WA, SPIE - The International Society for Optical Engineering (SPIE Proceedings. Volume 481), 1984, 1273 p. For individual items see A86-19491 to A86-19522. (SPIE-481)

Attention is given to sensing in the areas of land observation, meteorology, oceanography, and agriculture and hydrology. Among the specific topics addressed are: the multispectral linear array; optical-system design for next-generation pushbroom sensors; satellite remote sensing for aluminum and nickel laterites; the use of CSIS in severe weather prediction; review of experiments on the impact of satellite data on numerical weather prediction; and WINDSAT, a concept of global wind measurement by IF Doppler lidar. Also considered are: a GPS-based tracking system for TOPEX orbit determination; the low-frequency microwave radiometer for N-ROSS; an integrated approach to global crop monitoring, the microwave remote sensing of soil moisture; and the estimation of moisture conditions from AVHRR data. B.J.

A86-19861#

NATIONAL AND INTERNATIONAL COOPERATION IN REMOTE SENSING AND APPLICATIONS

R. J. KEATING (NOAA, National Environmental Satellite, Data, and Information Service, Washington, DC) AIAA, Aerospace Sciences Meeting, 24th, Reno, NV, Jan. 6-9, 1986. 8 p. (AIAA PAPER 86-0412)

This paper provides an overview of the United States remote sensing satellite systems and how they complement those of our foreign partners. In addition, the paper describes the international cooperative efforts to achieve complementarity and compatibility of these satellite systems. Specific uses of the data and their applications are described. Author

A86-21118#

REMOTE SENSING AND THE DEVELOPMENT PROCESS

C. K. PAUL (Agency for International Development, Washington, DC) and W. H. WIGTON (Agricultural Assessments International, Upper Marlboro, MD) IN: International Symposium on Remote Sensing of Environment, 18th, Paris, France, October 1-5, 1984, Proceedings. Volume 1. Ann Arbor, MI, Environmental Research Institute of Michigan, 1985, p. 201-205.

Science applied to the development process by private industry can increase productivity, capital, and employment. Local remote sensing institutions provide the baseline data for infrastructure planning. The technology of remote sensing is used in many developing countries for environmental assessment and management of natural resources. Remote sensing has proved its use in addressing the development sectors of agriculture, health, population, nutrition, education, water, housing, and energy. The technology becomes more effective when used with geographic information systems and models. Remote sensing carries social and economic considerations along with its known benefits. There are sensitivities to data collection in developing countries very different than those in the north. Costs of equipment and training are not only high and direct, but they are manifested in loss of opportunities to pursue other technologies which may or may not be more relevant to development problems in certain countries. Labor displacement by automated analysis equipment is a genuine concern. The need to learn how to manage projects and to conduct good business policy is acute. The reliance on machine complexity

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is risky. All of these factors must be taken into account; how they are will set the direction of remote sensing policy and applications. Author

A86-21119#

PLANNING FOR THE APPROPRIATE TRANSFER OF REMOTE SENSING TECHNOLOGIES INTO DEVELOPING COUNTRIES - RECOMMENDATIONS FOR AN INSTITUTIONAL IMPACT PROCESS

B. SELLMAN (Michigan, Environmental Research Institute, Ann Arbor) IN: International Symposium on Remote Sensing of Environment, 18th, Paris, France, October 1-5, 1984, Proceedings. Volume 1. Ann Arbor, MI, Environmental Research Institute of Michigan, 1985, p. 207-213. refs

The criteria for the planning and evaluating of remote sensing technology transfer processes are presented. The need for a realistic time frame in which to accomplish the objectives of the transfer, and the preparation of an estimate of the overall cost of the project are discussed. The training of a staff to operate the project and the establishment of educational programs to sustain it are examined. It is concluded that emphasis needs to be placed on the training of personnel and not on the purchasing of hardware. I.F.

A86-21120#

THE REGIONAL REMOTE SENSING FACILITY FOR EASTERN AND SOUTHERN AFRICA

V. A. O. ODENYO (Regional Remote Sensing Facility, Nairobi, Kenya) IN: International Symposium on Remote Sensing of Environment, 18th, Paris, France, October 1-5, 1984, Proceedings. Volume 1. Ann Arbor, MI, Environmental Research Institute of Michigan, 1985, p. 215-228. refs

The Regional Remote Sensing Facility in Nairobi, Kenya, was the first regional technology transfer program for remote sensing established by the United States Agency for International Development. It was initially funded in 1977, and serves 20 countries in eastern and southern Africa with a professional and support staff of sixteen people. The Facility has provided a technology transfer program of short term (3 weeks) and extended training courses, user assistance services and project support. Emphasis has been on analog techniques on Landsat obtained data. To date, more than 500 participants have benefited from the Facility's discipline-specific training courses. The three program areas are supported by an excellent black-and-white and color photo laboratory complex for processing Landsat images. The Facility has a vast imagery collection providing an extensive range of imagery products. Recent projects include soil and land capability mapping in Zambia, forestry mapping in Tanzania, highway corridor assessment in the Sudan, and experimental cartography products in Kenya, Swaziland and the Sudan. Many annotated images or image mosaics have been produced for distribution to potential users for information and demonstration. Customer-tailored images are often prepared at users' request. Author

A86-21121#

REMOTE SENSING ACTIVITIES IN LATIN AMERICA

N. J. PARADA (Instituto de Pesquisas Espaciais, Sao Jose dos Campos, Brazil) IN: International Symposium on Remote Sensing of Environment, 18th, Paris, France, October 1-5, 1984, Proceedings. Volume 1. Ann Arbor, MI, Environmental Research Institute of Michigan, 1985, p. 229-240.

This paper presents the status quo of remote sensing in Latin America. It opens with a brief discussion on the reasons, motivations, and importance of remote sensing activities in the Latin American environment. In the field of data reception, processing, distribution, and utilization, it presents the efforts made to improve those aspects which are vital to the whole process of remote sensing. Here, specific countries with their programs and projects are mentioned, briefly depicting the unique position of remote sensing in Latin America. It also concisely describes the Brazilian Remote Sensing Experiment (BRESEX) and its future utilization on the Brazilian Complete Space Mission to be carried out onboard the Shuttle. Finally, the importance of regional

societies, symposia and training programs is described, followed by conclusions and recommendations. Author

A86-21123#

THE NEEDS OF DEVELOPING COUNTRIES IN THE APPLICATION OF SATELLITE TECHNOLOGY FOR DISASTER MANAGEMENT

C. VOUTE (International Institute for Aerospace Survey and Earth Sciences, Enschede, Netherlands) IN: International Symposium on Remote Sensing of Environment, 18th, Paris, France, October 1-5, 1984, Proceedings. Volume 1. Ann Arbor, MI, Environmental Research Institute of Michigan, 1985, p. 247-261. refs

The possible use of space technology for disaster management is discussed in terms of disaster prevention, disaster preparedness and disaster relief operations, with emphasis on remote sensing applications. Specific needs of developing countries are identified. It is suggested that remote sensing imagery should not only be used for disaster prevention measures, disaster preparedness planning and damage assessment in case of emergencies, but also for audio-visual training programs and for on-site information of relief workers. Author

A86-21126#

USE OF SATELLITE DATA IN INTERNATIONAL DISASTER MANAGEMENT THE VIEW FROM THE U.S. DEPARTMENT OF STATE

L. A. ROSE (U.S. Department of State, Bureau of Oceans and International Environmental and Scientific Affairs, Washington, DC) and P. F. KRUMPE (Agency for International Development, Washington, DC) IN: International Symposium on Remote Sensing of Environment, 18th, Paris, France, October 1-5, 1984, Proceedings. Volume 1. Ann Arbor, MI, Environmental Research Institute of Michigan, 1985, p. 301-306.

Requirements are elaborated that must be met in a joint program wherein the U.S. Department of State and the U.S. Agency for International Development are actively exploring ways of using satellite data in emergency preparedness and disaster warning worldwide. Considerations that must be taken into account include: the limits of satellite technology and data in providing effective disaster warning; the fact that cost and competing claims on national resources do not permit research and development specifically targeted at creation of disaster early warning capabilities for satellites; the need of disaster-prone nations to provide substantial resources of their own to ensure that satellite warnings reach the affected areas in time; the continuing impossibility of precise prediction of natural disasters; and the long lead-time to establish a truly global disaster warning system. D.H.

A86-21132#

COMPLEMENTARY ROLE OF INDUSTRY IN UK NATIONAL REMOTE SENSING PROGRAMME

G. K. C. PARDOE (General Technology Systems, Ltd., Brentford, England) IN: International Symposium on Remote Sensing of Environment, 18th, Paris, France, October 1-5, 1984, Proceedings. Volume 1. Ann Arbor, MI, Environmental Research Institute of Michigan, 1985, p. 367-376. Sponsorship: Department of Trade and Industry. (Contract DTI-83004)

Industry can act as a driver to push forward the use of remote sensing technology in both the public and private sectors with substantial benefits flowing from the integration of new data sources into existing structures. For this enabling technology to be included in operational tasks, mechanisms must be in place to: archive the data, assist users to access the data, disseminate the data promptly to users, and integrate it into user work plans. Industry provides the vital link in ensuring that new technology programs result in commercial benefits. The United Kingdom program recognizes this complementarity between research and development groups and industry, acknowledges the compatible strengths of each, and has integrated both aspects into a national programme. Those aspects where industry can assist are outlined, as is the role of industry in the current UK program. Author

A86-21133#**VALUE ADDED SERVICES - THE INDUSTRY AND THE USER**

C. L. WILSON (Michigan, Environmental Research Institute, Ann Arbor) IN: International Symposium on Remote Sensing of Environment, 18th, Paris, France, October 1-5, 1984, Proceedings. Volume 1. Ann Arbor, MI, Environmental Research Institute of Michigan, 1985, p. 377-380.

'Value added service' is viewed from the perspective of the operations of the Earth Resources Data Center (ERDC) of the Environmental Research Institute of Michigan. 'Value added service' is defined and the market described in terms of size and customer mix. The industry and the user are described as are their attitudes and interests. The issues affecting Value Added Services, as perceived by the author, as they have occurred in the past and extrapolated to the future are presented. Finally, the concerns of the value added industry for the future are discussed. Author

A86-21134#**INDUSTRIAL INVESTMENT IN REMOTE SENSING**

G. TORDION (Societe Europeenne de Propulsion, Puteaux, France) IN: International Symposium on Remote Sensing of Environment, 18th, Paris, France, October 1-5, 1984, Proceedings. Volume 1. Ann Arbor, MI, Environmental Research Institute of Michigan, 1985, p. 381-385.

Remote sensing, as a new and fast growing field certainly proposes many attractive markets to industrial investors. On the other hand, remote sensing is a rather difficult and risky field for industrial investors, as it requires new technical and new technology for the solution of new problems. This paper discusses some of the issues related to how industrial investment takes place in remote sensing, based on the example and the experience of a French aerospace company which has developed an important activity in the remote sensing ground segment area. Author

A86-21135#**INDUSTRIAL DEVELOPMENT AND INTERNATIONAL COOPERATION [DEVELOPPEMENT INDUSTRIEL ET COOPERATION INTERNATIONALE]**

M. BIED-CHARRETON (Ministere des Relations Exterieures, Paris, France) IN: International Symposium on Remote Sensing of Environment, 18th, Paris, France, October 1-5, 1984, Proceedings. Volume 1. Ann Arbor, MI, Environmental Research Institute of Michigan, 1985, p. 389-397. In French.

Various aspects of the use of remote sensing to benefit developing countries are discussed. Particular consideration is given to: (1) the needs of developing countries with respect to remote sensing; (2) constraints on the utilization of remote sensing in an operational mode in developing countries; and (3) missions for industry. B.J.

A86-21137#**TROPICAL EARTH RESOURCES SATELLITE (TERS)**

R. VAN KONIJNENBURG (Nederlands Instituut voor Vliegtuigontwikkeling en Ruimtevaart, Delft, Netherlands) and M. IRSYAM (Indonesian National Institute of Aeronautics and Space, Jakarta, Indonesia) IN: International Symposium on Remote Sensing of Environment, 18th, Paris, France, October 1-5, 1984, Proceedings. Volume 1. Ann Arbor, MI, Environmental Research Institute of Michigan, 1985, p. 409-417.

Studies have been performed on the feasibility of a Tropical Earth Resources Satellite system, including a preliminary design of space and ground segment as well as studies on user aspects and the cloud distribution over Indonesia. The baseline of the Tropical Earth Resources Satellite (TERS) concept is a remote sensing satellite with a pushbroom optical instrument in a true equatorial orbit (1680 km). The TERS, conceived for the equatorial countries and Indonesia in particular, will complement the already existing or planned remote sensing satellites, and will especially improve the temporal resolution of the remote sensing data on these countries. It is anticipated that such a satellite will enable monitoring of critical processes in the field of food production, forestry, conservation of the natural environment and land usage.

The swath-width of the high resolution multispectral instrument can be pointed anywhere between latitude 10 deg N and 10 deg S, which will offer the equatorial countries an opportunity to observe any part of their territory four times per day during daylight. A forward looking cloud sensor will give the possibility to detect which areas are free of clouds and to point the observation instrument accordingly. Author

A86-21172#**LEAP - LANDSAT EMERGENCY ACCESS AND PRODUCTS, AN OPERATIONAL USE OF LANDSAT DATA FOR DAMAGE ASSESSMENT**

D. E. LICHY (U.S. Army, Corps of Engineering, Fort Belvoir, VA), D. PEPE (NOAA, Washington, DC), and N. D. LEPPERT (USDA, Washington, DC) IN: International Symposium on Remote Sensing of Environment, 18th, Paris, France, October 1-5, 1984, Proceedings. Volume 2. Ann Arbor, MI, Environmental Research Institute of Michigan, 1985, p. 835-844.

Procedures developed for the LEAP (Landsat Emergency Access and Products) program are described. In the fall of 1983, the National Oceanic and Atmospheric Administration (NOAA), which operates the Landsat MSS, in cooperation with the U.S. Army Corps of Engineers, developed, tested, and evaluated procedures for the acquisition of Landsat imagery in response to natural and national disasters. The prime purpose of LEAP is to provide satellite imagery to the requester within 12 to 24 hours after acquisition by the spacecraft. Several case studies of the Corps of Engineers and the U.S. Department of Agriculture have successfully been tested. Procedures to integrate the new products are presented; the user community must develop special methods for handling LEAP data. D.H.

A86-21518**REMOTE SENSING - A FORMIDABLE TOOL FOR MANKIND**

G. K. C. PARDOE Space (ISSN 0267-954X), vol. 1, June 1985, p. 12-15, 17.

A state-of-the-art assessment is made of the performance capabilities and applications impact of satellite-borne earth sensing techniques (false color photography, synthetic aperture radar, etc.) as carried out by such spacecraft as Nimbus, Seasat and Landsat. The remote sensing prospects offered by NASA's projected Space Station are discussed, and the development status and performance capabilities of the Tropical Earth Resource Satellite and the SPOT remote sensing satellite of France are noted. Attention is given to the need for intersatellite data links. O.C.

A86-22827**THE SPOT PROGRAM - ORGANIZATION AND DATA DISTRIBUTION POLICY**

G. BRACHET (SPOT Image, S.A., Toulouse, France) IN: SPOT simulation applications handbook; Proceedings of the SPOT Symposium, Scottsdale, AZ, May 20-23, 1984. Falls Church, VA, American Society of Photogrammetry, 1984, p. 3-7.

The SPOT program was initiated in 1978 by the French Government in cooperation with Belgium and Sweden, and is managed by the French Space Agency (CNES). The first in a series of SPOT satellites will be launched in 1985. SPOT's High Resolution Visible (HRV) imaging instruments provide for 10m resolution panchromatic and 20m multispectral imagery and the ability to look cross-track up to 27 degrees off nadir to allow for stereoscopic observations and improved accessibility. The spacecraft are operated by CNES which owns the data copyright. The SPOT data distribution is carried out on a commercial basis by SPOT IMAGE. The ground system includes a network of regional receiving stations, all of which contribute to a central data bank managed by SPOT IMAGE. Data are distributed by national or regional receiving stations, licensed distributors, and SPOT IMAGE subsidiary corporations. The policy for data dissemination is non-discriminatory both for 20m and 10m resolution images. Competition in the production and distribution of value-added SPOT products is anticipated and encouraged. Author

09 GENERAL

A86-26465

EARTH OBSERVATION SATELLITES - FROM TECHNOLOGY PUSH TO MARKET PULL

G. BRACHET (SPOT Image, Toulouse, France) IN: Space: The commercial opportunities; Proceedings of the International Business Strategy Conference, London, England, October 31, November 1, 1984. Pinner, England, Online Publications, 1984, p. 165-183.

The present trend towards commercial operation of high resolution observation satellites of the earth's surface will have a profound effect on the market for remote sensing data as well as on the industry for data enhancement and interpretation. The present situation is described, including satellites programs planned for the medium term, and the role of hardware, software and service industry is stressed. Author

N86-16696# Committee on Science and Technology (U. S. House).

LANDSAT COMMERCIALIZATION

Washington GPO 1985 84 p Hearing before the Comm. on Sci. and Technol., 99th Congr., 1st Sess., No. 30, 13 Jun. 1985 (GPO-49-336) Avail: Subcommittee on Natural Resources, Agriculture Research and Environment and Subcommittee on Space Science and Applications

Hearings were held in the U.S. House of Representatives by the Subcommittee on Natural Resources, Agriculture Research and Environment, and the Subcommittee on Space Science and application on the commercialization of the LANDSAT Program. The goal was to establish a commercial U.S. civil operation land-observing satellite program. E.A.K.

N86-17830# International Training Centre for Aerial Survey, Enschede (Netherlands).

ACTIVITIES REPORT IN REMOTE SENSING TRAINING Annual Report, 1983

1983 36 p refs

Avail: NTIS HC A03/MF A01

International cooperation in training and research in photogrammetry; aerial photography; cartography; land resource surveys and rural development; Earth resources surveys; and urban surveys and human settlements analysis are described.

Author (ESA)

N86-18373# Joint Research Centre of the European Communities, Ispra (Italy).

THE JOINT RESEARCH COMMITTEE (JRC) PROGRAM ON REMOTE SENSING

S. R. GALLIDEPARATESI IN ESA Proceedings of EARSeL/ESA Symposium on European Remote Sensing Opportunities: Systems, Sensors, and Applications p 141-150 Jun. 1985 refs

Avail: NTIS HC A12/MF A01

The European Economic Communities' Program on Remote Sensing for 1984 to 1987 is oriented towards land and marine applications to contribute to the feasibility study and concept of an advanced information system for agriculture, and of an advanced coastal pollution monitoring system, both using satellite and/or aircraft remote sensing data to be integrated with conventional data. Projects are: Rural Land Use Applied to European Less Favored Areas; Food Agriculture Resources in Sahelian Countries; and Coastal Transport of Pollutants and Oil Characterization by Laser-induced Fluorescence. Exercises of oil detection at sea are organized. A feasibility study on the use of space remotely sensed data as an aid to management of natural disasters is outlined.

Author (ESA)

N86-18374# Royal Aircraft Establishment, Farnborough (England). National Remote Sensing Center.

EUROPEAN REMOTE SENSING: FUTURE NEEDS IN EDUCATION

R. K. BULLARD IN ESA Proceedings of EARSeL/ESA Symposium on European Remote Sensing Opportunities: Systems, Sensors, and Applications p 151-156 Jun. 1985 refs

Avail: NTIS HC A12/MF A01

The education of people in Europe in the subject remote sensing is discussed. The range of education should extend from primary to tertiary and beyond to the public at large. The promotional role of education is to bring remote sensing to public attention in a less formal way and to achieve this there is a need for wide publicity including the press, television, radio, articles in journals and newspapers, videos, books, and slide sets. The cost of promotion may be directly related to the product while the reaction and response to it from the media and the public interest depend partly on its continuing inclusion in National programs and the justification of its applications. Author (ESA)

N86-18379# European Space Agency, Paris (France).

SPACE STATION: ESA VIEWS ON REQUIREMENTS FOR EXPERIMENTAL AND OPERATIONAL EARTH OBSERVATION MISSIONS

G. DUCHOSSOIS IN its Proceedings of EARSeL/ESA Symposium on European Remote Sensing Opportunities: Systems, Sensors, and Applications p 189-199 Jun. 1985 refs

Avail: NTIS HC A12/MF A01

The requirements of spaceborne experimental and operational Earth observations are reviewed, and an unmanned polar platform element, composed preferably of two platforms in adequately phased orbits is recommended as part of the European contribution to the US Space Station. Possible configuration and resources capabilities for such platforms are provided, together with candidate payloads. Author (ESA)

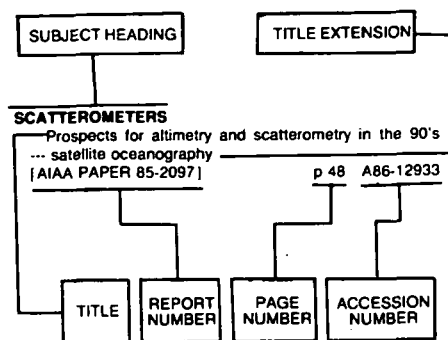
N86-20183# Joint Publications Research Service, Arlington, Va. **INTERVIEW WITH COSMONAUTS KIZIM AND SOLOVYEV**

G. I. VOROBYEV IN its USSR Report: Space (JPRS-USP-86-001) p 63-70 13 Jan. 1986 Transl. into ENGLISH from Zemlya i Vselennaya (Moscow, USSR), no. 2, Mar. - Apr. 1985 p 16-22

Avail: NTIS HC A03

An interview with Salyut-7 cosmonauts who completed a 237 day mission space is given. Spaceborne experiments in medicine, oceanography, astrophysics and mineral exploration are discussed. R.J.F.

Typical Subject Index Listing



The subject heading is a key to the subject content of the document. The title is used to provide a description of the subject matter. When the title is insufficiently descriptive of the document content, the title extension is added, separated from the title by three hyphens. The (NASA or AIAA) accession number and the page number are included in each entry to assist the user in locating the abstract in the abstract section. If applicable, a report number is also included as an aid in identifying the document. Under any one subject heading, the accession numbers are arranged in sequence with the AIAA accession numbers appearing first.

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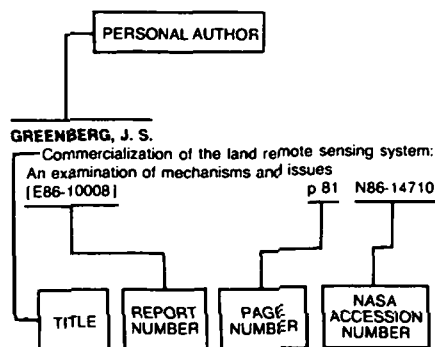
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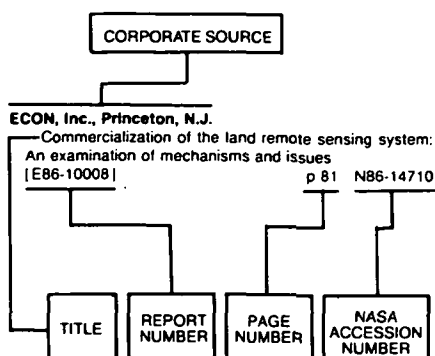
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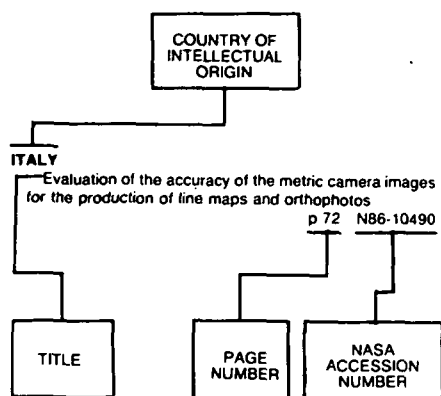
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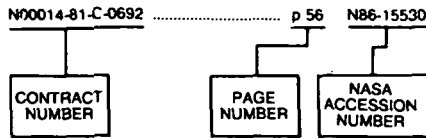
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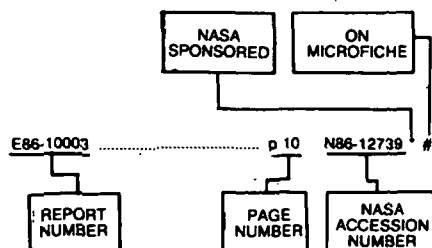


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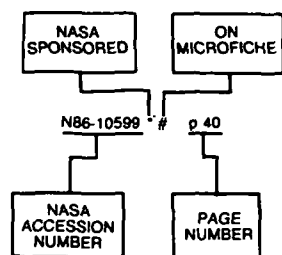
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Baton Rouge, LA 70803
(504) 388-2570

LOUISIANA TECHNICAL UNIV. LIBRARY

Documents Department
Ruston, LA 71272
(318) 257-4962

MAINE

UNIVERSITY OF MAINE
Raymond H. Fogler Library
Tri-State Regional Documents
Depository
Orono, ME 04469
(207) 581-1680

MARYLAND

UNIVERSITY OF MARYLAND
McKeldin Lib.—Doc. Div.
College Park, MD 20742
(301) 454-3034

MASSACHUSETTS

BOSTON PUBLIC LIBRARY
Government Docs. Dept.
Boston, MA 02117
(617) 536-5400 ext. 226

MICHIGAN

DETROIT PUBLIC LIBRARY
Sociology Department
5201 Woodward Avenue
Detroit, MI 48202
(313) 833-1409

MICHIGAN STATE LIBRARY

P.O. Box 30007
Lansing, MI 48909
(517) 373-0640

MINNESOTA

UNIVERSITY OF MINNESOTA
Government Pubs. Division
409 Wilson Library
309 19th Avenue South
Minneapolis, MN 55455
(612) 373-7813

MISSISSIPPI

UNIV. OF MISSISSIPPI LIB.
Documents Department
University, MS 38677
(601) 232-5857

MONTANA

UNIV. OF MONTANA
Mansfield Library
Documents Division
Missoula, MT 59812
(406) 243-6700

NEBRASKA

NEBRASKA LIBRARY COMM.
Federal Documents
1420 P Street
Lincoln, NE 68508
(402) 471-2045
In cooperation with University of
Nebraska-Lincoln

NEVADA

UNIVERSITY OF NEVADA LIB.
Govt. Pub. Department
Reno, NV 89557
(702) 784-6579

NEW JERSEY

NEWARK PUBLIC LIBRARY
5 Washington Street
Newark, NJ 07101
(201) 733-7812

NEW MEXICO

UNIVERSITY OF NEW MEXICO
Zimmerman Library
Government Pub. Dept.
Albuquerque, NM 87131
(505) 277-5441

NEW MEXICO STATE LIBRARY

Reference Department
325 Don Gaspar Avenue
Santa Fe, NM 87501
(505) 827-2033, ext. 22

NEW YORK

NEW YORK STATE LIBRARY
Empire State Plaza
Albany, NY 12230
(518) 474-5563

NORTH CAROLINA

UNIVERSITY OF NORTH CAROLINA AT CHAPEL HILL
Wilson Library
BA/SS Documents Division
Chapel Hill, NC 27515
(919) 962-1321

NORTH DAKOTA

UNIVERSITY OF NORTH DAKOTA
Chester Fritz Library
Documents Department
Grand Forks, ND 58202
(701) 777-2617, ext. 27
(In cooperation with North
Dakota State Univ. Library)

OHIO

STATE LIBRARY OF OHIO
Documents Department
65 South Front Street
Columbus, OH 43215
(614) 462-7051

OKLAHOMA

OKLAHOMA DEPT. OF LIB.
Government Documents
200 NE 18th Street
Oklahoma City, OK 73105
(405) 521-2502

OKLAHOMA STATE UNIV. LIB.
Documents Department
Stillwater, OK 74078
(405) 624-6546

OREGON

PORTLAND STATE UNIV. LIB.
Documents Department
P.O. Box 1151
Portland, OR 97207
(503) 229-3673

PENNSYLVANIA

STATE LIBRARY OF PENN.
Government Pub. Section
P.O. Box 1601
Harrisburg, PA 17105
(717) 787-3752

TEXAS

TEXAS STATE LIBRARY
Public Services Department
P.O. Box 12927—Cap. Sta.
Austin, TX 78753
(512) 471-2996

TEXAS TECH UNIV. LIBRARY

Govt. Documents Department
Lubbock, TX 79409
(806) 742-2268

UTAH

UTAH STATE UNIVERSITY
Memill Library, U.M.C. 30
Logan, UT 84322
(801) 750-2682

VIRGINIA

UNIVERSITY OF VIRGINIA
Alderman Lib.—Public Doc.
Charlottesville, VA 22901
(804) 924-3133

WASHINGTON

WASHINGTON STATE LIBRARY

Documents Section
Olympia, WA 98504
(206) 753-4027

WEST VIRGINIA

WEST VIRGINIA UNIV. LIB.
Documents Department
Morgantown, WV 26506
(304) 293-3640

WISCONSIN

MILWAUKEE PUBLIC LIBRARY
814 West Wisconsin Avenue
Milwaukee, WI 53233
(414) 278-3000

ST. HIST LIB. OF WISCONSIN

Government Pub. Section
816 State Street
Madison, WI 53706
(608) 262-4347

WYOMING

WYOMING STATE LIBRARY
Supreme Ct. & Library Bld.
Cheyenne, WY 82002
(307) 777-6344

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